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A PROMISING LOCOMOTIVE.

For traction purposes with heavy loads, high speeds and long distances, the steam locomotive, through a gradual course of evolution, has reached a remarkable fitness. The transmission system between the steam cylinders and the wheels is simple, efficient and generally effective. In spite of this there has been a great deal of experimenting on a steam locomotive using an electrical transmission system between the steam engine and the wheels. So long as the reciprocating steam engine remains the best recognized transformer of thermal into mechanical power, there is not much to be gained in the Heilmann locomotive over the conventional steam locomotive. If, however, as seems probable, the steam turbine, the gas engine or possibly the successor of both, namely, the gas turbine, develops any considerable advantage over the reciprocating steam engine, it will be practically impossible to utilize them for traction purposes with mechanical driving, and the advantages of an electrical transmission system on the locomotive will be thereby greatly enhanced.

In another column will be found a description of the Patton motor car, in which the prime mover is an internal combustion gasoline engine. This drives the dynamo, the power of which is transmitted to ordinary traction motors on the truck. A considerable advantage over the Heilmann locomotive is obtained by the further addition of a storage battery, the weight of which is not only permissible on account of the absence of a boiler, but almost necessary for proper adhesion. The duties required in such work of the storage battery are those for which it is best adapted, namely, the smoothing out of intermittent brief overloads, the energy for the same being almost immediately returned on the periods of light load.

In a paper read at a recent New York meeting of the Society of Naval Architects and Marine Engineers, Mr. Charles E. Wheeler, discussing the rivalry between rail and water transportation, mentioned the development of the internal combustion engine and the advantage which it will probably give to water transportation, but unavailable for rail traction. The particular engine which he mentioned was a compound gas engine of about 100 indicated horse-power, with the remarkably high output of 92 horse-power per ton, and the remarkable thermal efficiency of approximately 40 per cent. He states: "I mention it because indicative of a possible revolution in mechanics that will work economies in the engine room of a vessel impossible to the locomotive, and thus increase the already marked difference between the cost per ton mile by water and that by rail." With the electrical transmission system it will be hard to find a source of power applicable to vessel propulsion that cannot be used in rail traction.

MATHEMATICS IN MOTOR CALCULATIONS.

There seems to be two schools of motor and dynamo design. The adherents of the rule-of-thumb method cavil greatly at those who approach the task with mathematical analysis, while the mathematicians have an ill-concealed contempt for the practicians who avail themselves of the time-honored "cut and try" method. In another column in this issue, Mr. William Baxter, Jr., has discussed the question of the calculation of direct current constant potential motors, and takes the ground that the multiplication of formulæ

for the calculation of motors of this class is not only unnecessary, but really a step in the wrong direction. It has always seemed that the labor of making elaborate calculations for motors of this class is, in a degree, wasted. Mr. Baxter points out the fact that motors are not made one by one, but are generally manufactured in large quantities and to certain standard requirements. When the type is once standardized their subsequent manufacture consists in duplication. It is more than likely that the large majority of commercial motors have reached their present perfection through a variety of evolution, where the results of calculation in the first place have been subjected to the test of manufacture and modified by observations upon the results. Since it is impossible to obtain two motor frames of identical magnetic qualities, the product, even with the most careful standardization, will vary somewhat. Consequently, the most careful calculation, taking into account all the factors governing the case, would frequently have to rely upon an experimental basis, in which the actual frame of the motor was tested under conditions approximating those of actual use.

The other side of the question, however, has equally strong claims to recognition. The design of a new type of motor cannot be attempted successfully without a considerable application of the comparatively simple mathematics of the subject. Probably the difficulty which harasses many designers and most students of this subject is that the mathematical expressions do not always convey to them the corresponding physical ideas. It can be laid down as a sort of axiom that whatever can be expressed in plain English and conveyed to the mind through purely physical ideas is not so well set forth by an equation or a formula. Nothing can ever be gotten out of a mathematical expression beyond what is put into it. Mathematics is a language into which thought is translated for its easier expression, and the notation adopted is a sort of mental shorthand. To those who regard mathematics as a kind of jugglery with symbols its methods seem entirely mysterious, but it is absolutely true that every step in a mathematical analysis is simply the expression, in another form, of a more or less simple mental conception or physical reality.

It seems, therefore, that the difference between the two ways of approaching the problem under discussion consists only in the method of expressing the necessary sequence of ideas that lead to similar designs in the end. Probably to the end of time those who think best in mathematics will use the mathematical method, while those who prefer to express their ideas in concrete fashion will continue to use the rule-of-thumb method. A combination of the two, with the admixture of a considerable quantity of common sense, is probably the best method that can be used for this or any other variety of electrical design.

THE ROTARY TRANSFORMER.

The rotary transformer, in which alternating and direct currents are simultaneously active in one winding, is now the object of a great deal of study and investigation, owing to its value in long distance power transmission systems, from which it is desirable to obtain direct current. In general design it consists simply of a direct-current generator, without mechanical driving attachments, but with collector rings suitably connected to the armature winding. Unlike the direct-current generator, which it so closely resembles, the voltage of the machine is not dependent on the field excitation. In fact, some machines are made to give full voltage at the direct-current end, with no field excitation whatever. This independence of the field excitation is due to the fact that the rotary is virtually a synchronous motor on the alternating-current side, and, as is well known, the alternating synchronous motor will run with any field excitation whatever, the machine automatically adjusting its own back E. M. F. by permitting, so to speak, wattless currents to enter its armature windings and induce a proper field strength. For instance, if a synchronous motor is run without field excitation, wattless lagging currents will induce a field sufficient to provide the necessary back E. M. F. If the motor is run with the field excitation more than sufficient to give the proper back E. M. F., wattless leading currents will enter the armature windings and cut down the field strength to the proper limit.

The ratio of the direct-current E. M. F. to the alternating-current E. M. F. is thus approximately a constant, independent of the field excitation. When, therefore, it is desired to vary the voltage of the direct current within wide limits, as is the case in the chemical works described in another column, some special method has to be adopted to vary the alternating E. M. F. In this particular instance it is impossible to vary the impressed alternating E. M. F. on the line; therefore, the static transformers which reduce the pressure of the alternating current from that of the line to that suitable for the rotary were made adjustable. By their manipulation the voltage of the alternating current supplied to the rotary can be varied, thereby varying the voltage drawn off from the direct-current end.

In order to provide for the rise of voltage usually effected by over-compounding, necessary on street-railway systems with the increase of load, the very ingenious arrangement described by Mr. Charles P. Steinmetz in The Electrical World of November 13 is sometimes adopted. In this arrangement a certain amount of self-induction is interposed in the alternating-current lines feeding the rotary transformer. The latter is excited by a compound winding, so proportioned that on no load the field excitation will be less than that necessary to give the proper back E. M. F. Lagging currents will then pass through the rotary, and by their reaction on the self-induction of the line the line drop will be increased. As the load rises the series winding will increase the excitation of the fields to a point at full load exceeding that necessary to give the proper back E. M. F. Leading currents will then be necessary to bring the field strength down to the proper point. These leading currents, like a condenser, react on the self-induction of the line to raise the voltage at the receiving end to a value greater than that of the transmitting end, minus the ohmic drop. Properly proportioned, the voltage at the receiving end can be made even greater than that at the transmitting end, with a heavy load on the line. In this way the voltage at the direct-current end of the rotary can be over-compounded, just as though the machine were driven mechanically, although the compounding is done not in the rotary, but, strange as it may seem, in the inductive transmission line.

The method of starting the rotaries at the Mathieson Alkali Works, by means of an induction motor trundled into place on a hand-truck and belted to the rotary, is certainly peculiar and apparently rather primitive. Rotaries are readily self-starting, with unexcited fields, from the alternating-current end, by virtue of an induction-motor action, the solid field-poles serving as a short-circuited secondary. Once any one of the rotaries is running, any other can obviously be started as a shunt motor on the direct-current end. This method is, however, more readily applicable to rotaries working in multiple on a common set of bus-bars than to those working independently, as in the plant described.

The Guatemalan Tariff on Electrical Supplies.

The Government of Guatemala has recently promulgated a decree admitting free of duty electric batteries, uncharged, for public purposes. Galvanized iron wire and insulated copper wire for electrical purposes, and electrical apparatus, are subject to a duty on the basis of their gross weight.

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An Electric Curve Tracer—I.

FOR DELINEATING THE FORMS AND PHASES OF PERIODIC ELECTRIC QUANTITIES, VIZ., ELECTRIC CURRENTS, E. M. FS., ELECTRIC POWER, MAGNETIC INDUCTION, AND HYSTERESIS CURVES.

BY PROF. EDWARD B. ROSA.

Undoubtedly one of the most interesting and fruitful methods of study and investigation of alternating current phenomena is the tracing of the forms and phases of alternating current waves. Without these curves one can gain only a very inadequate idea of the inner workings of a dynamo, motor or transformer. And considering the rapid multipliaation of alternating current apparatus, both of single phase or multiphase varieties, it is evident that the field of usefulness of alternating current diagrams, already very great, is constantly increasing.

The practicability of this method of investigation and testing has been seriously limited by the great labor of obtaining the curves and the insufficient accuracy of the curves when obtained. To find and plot a dozen or two points, and then draw a smooth curve through them and call it the curve of current or E. M. F. will sometimes answer, for want of something better. But it is often unsafe to infer very much from such a curve. What is wanted is so

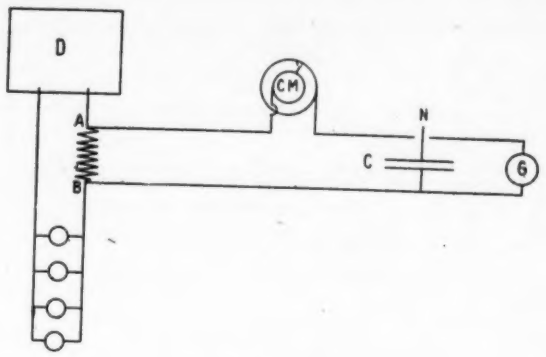


FIG. 1.

large a number of points as to be practically equivalent to a continuous line, marking exactly the fluctuations of the current. And when several such related curves have been drawn to scale on a single sheet, showing the forms, phases and relative amplitudes of the currents and E. M. Fs. (and, perhaps, also the magnetizations and power waves), which are concerned in the operation of a given machine or system, we have a beautiful picture of what in algebraic language merely is not very attractive.

Various methods of obtaining these curves have been employed. An instantaneous contact maker, connected with the armature of the dynamo, is generally used. The disc of the contact maker revolves

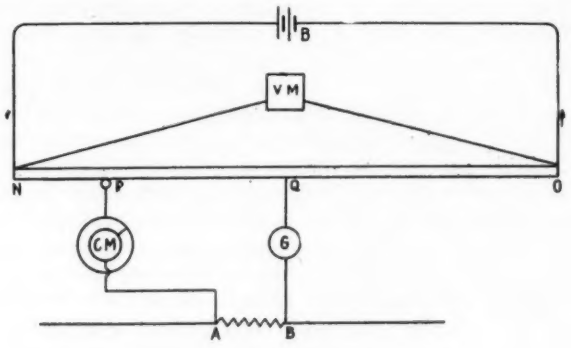


FIG. 2.

with the same angular speed as the dynamo, and a brush which rests upon its edge makes contact once in every revolution with a knife edge let into the disc. As the brush is advanced step by step, contact is made at later instants in the phase; but while the brush is at rest in any position the current and E. M. F. return to the same value at each successive instant of contact. The value of current at the instant of contact (Fig. 1) is determined by measuring the difference of potentials of the terminals, *A B*, of a known resistance through which the current flows. This potential difference is sometimes ascertained by joining a condenser *C*, Fig. 1, to *A B* by a switch *N*, through the contact maker *M*, and then discharging the condenser through a ballistic galvanometer. Under these circumstances the charge of the condenser will be proportional to the difference of potential between *A* and *B* at the instants of contact in *M*, and this in turn is proportional to the corresponding instantaneous value of the current flowing from the dynamo. The position of the contact brush is then advanced, the condenser is again charged and discharged, and a second value of the current, corresponding to the new phase of contact, is obtained. Or an electrometer may be substituted for the galvanometer, and its deflection read at each setting of the brush. In this way a number of points may be obtained and plotted out on cross-section paper, and a curve drawn through them. But if the number of points is sufficient to give an accurate curve, the time and labor required are very great. Moreover, it may be impossible to keep the circumstances of the circuit constant for so long a time, and the later ones of a set of curves will not therefore correspond with the first.

THE POTENTIOMETER METHOD.

In the following potentiometer method readings can be taken more rapidly as well as more accurately than by using a ballistic galvanometer or electrometer. A hard rubber rod anywhere from sixty to 100 cms. in length is wound with one layer of copper or German silver wire. If the wire is bare, the rod may be threaded in a lathe, and this will secure insulation and uniformity of winding; if insulated, the insulation may be removed along the top side, so that a sliding contact piece passing over it will always make good contact. (Fig. 2.) A current from two or three storage cells flows through this potentiometer coil and by means of a voltmeter and adjustable resistance

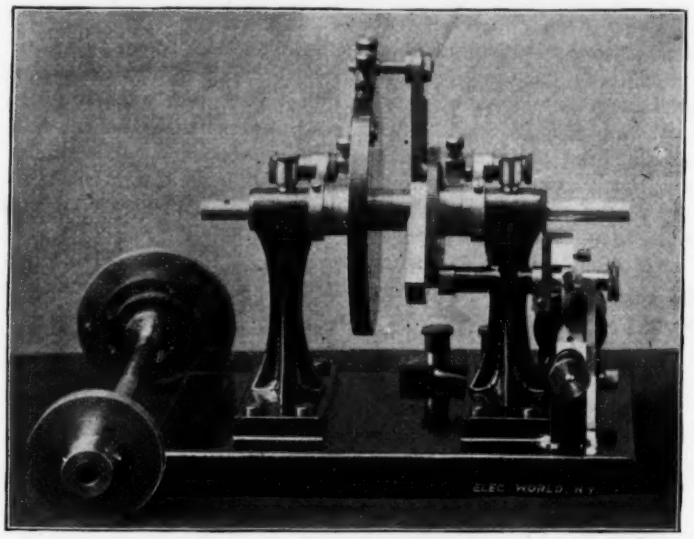


FIG. 3.

the difference of potential of the ends of the coil is maintained constant. The instantaneous difference of potential at the terminals of *A B* is now measured by matching it against the known difference of potential of a part of the coil *N O*. The point *Q*, at the middle of *N O*, is joined through a galvanometer to *B*, while *P*, a sliding contact, is joined through the revolving contact maker *M* to the point *A*. When the differences of potential at *A B* and *P Q* are equal there is no deflection of the galvanometer. *P* is therefore moved in the direction indicated by the galvanometer deflection until the latter is reduced to zero. The distance *P Q* is then proportional to the current through *A B*; and knowing the difference of potential *P Q* and the resistance *A B* we determine at one the precise value of the current. The brush of the contact maker may then be advanced, when the new setting of *P* will give the new instantaneous value of the current through *A B*. The galvanometer should be dead-beat, quick and fairly sensitive. A D'Arsonval meets the conditions admirably, and indicating as it does the direction in which *P* must be moved to secure a balance is superior to a telephone, which could be used. When the current is flowing from *A* to *B*, *A* will be at the higher potential and *P* will fall somewhere on the left of *Q*. If, however, the current is from *B* to *A*, then *P* is on the right of *Q*. If the potentiometer coil is uniformly wound, and the settings of the sliding contact carefully made, this method gives very accurate results, and with less labor than most step-by-step methods. But at the best it is slow and laborious. If one undertakes to determine a large number of curves the successive settings of the brush are very tedious. The scale

readings of the contact P must all be taken and recorded, and finally after these readings have been reduced the curve is plotted out carefully by hand. One does this very willingly for a while, but if he attempts to determine accurately a considerable number of curves the work becomes a burden.

AN AUTOMATIC INSTRUMENT.

It was while engaged in this kind of work nearly two years ago that I undertook to devise an apparatus that should reduce the labor and increase the speed of drawing electric curves. The apparatus which is shown in Figs. 3 and 4 is the outcome of this endeavor. The most laborious parts of the operation, including setting the contact brush, are done automatically by the machine, and the work of

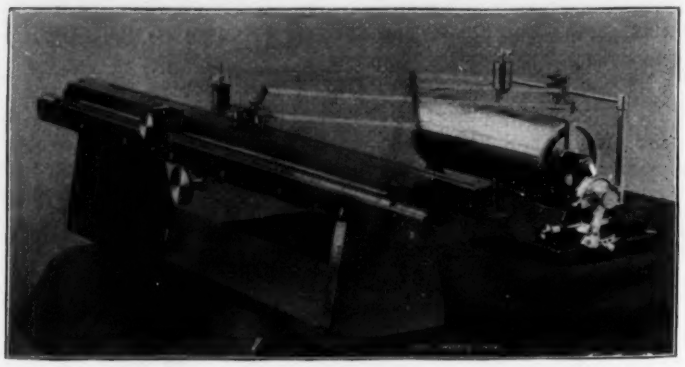


Fig. 4.

several hours may be done in as many minutes. The measurements are made by the foregoing potentiometer method, the results are simultaneously plotted by the machine more accurately than they could be plotted by hand, and a curve being obtained in a few minutes the speed, voltage and other circumstances may be maintained more nearly constant than would be possible when the observations extend over several hours. For these reasons the curves obtained are of unprecedented accuracy.

To avoid the labor of reading, recording, reducing and plotting the various values of the current and E. M. F., a pantograph is employed to print the curve automatically as the settings are

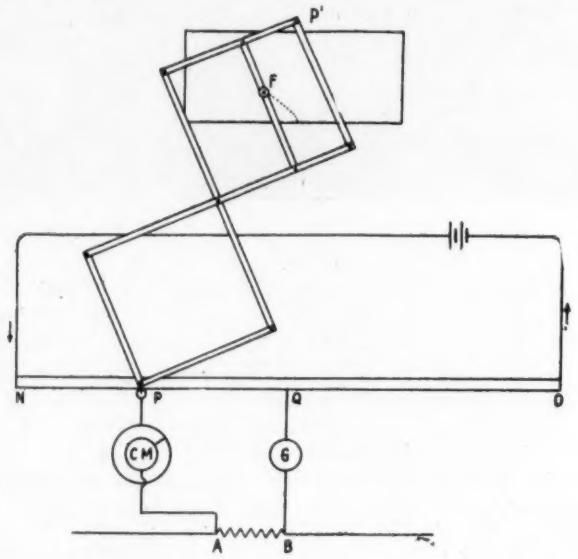


Fig. 5.

made. The pantograph has one end fixed at P′ (Fig. 5) and the other end fixed to the carriage to which is attached the movable contact P. On an extra bar the printing electromagnet F is carried; and as the carriage and sliding contact P move to and fro along the spiral, F moves to and fro in a parallel line, at a reduced speed. The distance of F from its zero position is therefore always proportional to $P\ Q$; that is, to the value of the current at the instants of contact. Hence by printing a point directly under F upon a sheet of paper carried by a cylinder or plate the instantaneous value of the current is permanently registered. This is done by closing a key, when an electric current passes through F and throws a steel point down upon a typewriter ribbon, printing a dot on the paper beneath it. This current also passes through an electromagnet on the contact maker and another on the record cylinder, attracting their armatures against the stop pins (see Figs. 3 and 4). When the key is released and the current broken these armatures are drawn back into their former positions by springs, and at the same time a pawl on each engages a ratchet wheel and advances it one or more teeth, according to the position of its stop pin. Thus, closing the circuit prints a point upon a sheet of cross-section paper, which permanently records the value of the current. Breaking the circuit an instant later causes the brush and cylinder to advance ready for a new setting of P and another point on the paper.

DRAWING THE CURVES.

The galvanometer used is a quick dead-beat D'Arsonval, and settings are made rapidly. The carriage, to which the sliding contact and pantograph are attached, is moved to and fro by a cord which passes over pulleys at the ends, and is wound over a drum underneath the potentiometer coil. This drum is turned by a milled head, shown in the photograph. The observer keeps his eye fixed upon the galvanometer scale. With his left hand he turns the milled head, and so adjusts the sliding contact; with his right he works the contact key. As soon as the latter is opened the brush advances, and the spot of light on the scale goes off the zero, to the right or left, according as the current has decreased or increased. The contact, P, is immediately moved in the same direction until the spot of light is brought back to zero, when the circuit is again closed, a point is

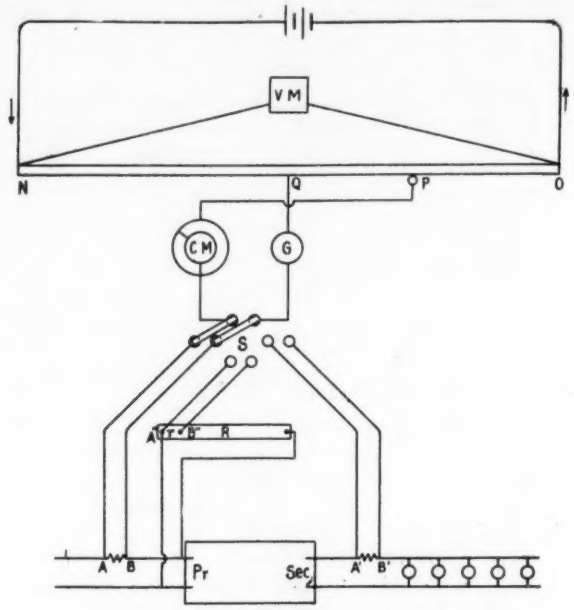


Fig. 6.

printed, the brush advances, the spot of light again goes off the zero, etc. Twenty points a minute can be printed after some practice.

A second electromagnet mounted on the carriage prints a pencil point (if desired) on a strip of paper whenever the first one prints a point on the record sheet. Duplicate curves can then be printed by setting the pencil point over these dots, without running the dynamo, and curves originally printed on separate sheets can be combined on the same sheet. Typewriter ribbons of different colors are used for different curves, so that the curves are easily distinguished, even though they be considerably interlaced. The teeth of the two ratchet wheels are numbered, so that the contact brush and record cylinder can be set at any particular position desired. In drawing a curve their initial positions are noted (Fig. 6), and when the curve is finished (suppose it represents the E. M. F. of a dynamo) the brush and cylinder are turned back to the initial position, the switch S thrown so as to connect to the points $A\ B$ of the primary circuit of the transformer, and the primary current is drawn. Turning back again to the initial position, and joining to $A'\ B'$ of the secondary circuit, the secondary current is drawn. The difference of phase of these waves will then be accurately represented by their distance apart on the record sheet. The cylinder is 360 millimeters in circumference, and two complete wave lengths extend once around it. One wave is therefore 180 millimeters long on the record sheet, and 1 millimeter is 2°. Hence differences of phase are easily determined by counting the distance in millimeters on the record sheet.

THE SCALE OF THE CURVES.

The non-inductive resistances, $A\ B$, and $A'\ B'$, are adjustable, so that any given current may be drawn to a suitable scale, which is chosen in advance. The potentiometer coil is 80 millimeters long,

and the pantograph reduces the scale in the ratio of 5 to 1. Hence, if the difference of potential of the ends of the coil is four volts, one volt corresponds to 20 centimeters on the coil or 4 centimeters on the record sheet. If the resistance of *A B* is one-fourth ohm, four amperes would give a potential difference of one volt, and this would be plotted on the paper as an ordinate 4 centimeters high. Thus the scale of the curve would be one ampere per centimeter. If the resistance of *A B* is one-eighth ohm, the scale would be two amperes per centimeter; if one-fortieth ohm, ten amperes per centimeter, etc. If the cross section paper is (Figs. 7 and 8) ruled in inches and tenths or twentieths, as is the case with what I have generally used, the scale works out similarly. Eighty centimeters equal 31.5 inches; one-fifth of this is 6.3 inches, the extreme range on the paper. Let the difference of potential of the ends of the potentiometer coil be maintained at 6.3 volts. Then one volt on the coil corresponds to one inch on the paper. If *A B* has a resistance of one-fourth ohm the scale of the curve is four amperes per inch; if one-eighth ohm, eight amperes per inch; if one-fortieth ohm, forty amperes per inch, etc.

If the non-inductive resistance *R* is 2000 ohms, and *r*, a part of it, is 20 ohms, that is 1-100 of the total, then, since the difference of potential of *A" B"* is drawn out on the second sheet on a scale of one volt per inch, the scale of the E. M. F. curve will be 100 volts per inch. If *A" B"* is 10 ohms, then the scale of the curve is 200 volts per inch, etc. In a similar manner power curves, magnetic induction curves, and hysteresis curves are drawn to a known scale.

DERIVED CURVES.

Magnetic induction curves are not drawn directly, but are derived from the E. M. F. curves. Writing down from the curve the instantaneous values of the E. M. F. for a single period, and summing them up, we get a series of values of the induction which are laid off upon a strip of paper. This is placed upon the curve tracer precisely as when duplicating curves, and the curve of magnetic induction is printed upon the record sheet, showing its proper phase relation to the other curves. Its position is determined by the consideration that the induction is stationary, usually a maximum, when the E. M. F. is zero.

Hysteresis curves are derived from the curves of current and magnetic induction already drawn, and include the eddy current loss with the hysteresis loss. The current, which has magnetized the iron under investigation, is printed on a narrow strip of paper, and attached to the end of the record cylinder at right angles to its position when printed. Two persons are required. One sets the pointer attached to the carriage upon the first point of the strip of the induction curve, while the other observer, taking the ratchet wheel in his left hand, sets the cylinder so that the first point of the current curve comes directly under a fixed line above the cylinder. A point is then printed on the record sheet, when the two observers advance to the second points, print a second dot, etc. The result is a closed curve.

Electrical Affairs in Colombia.

Advices received at the State Department, Washington, from Consul Bidlake, at Barranquilla, Colombia, are to the effect that the electric light plant in that city has received offers from Italy of ordinary 3.1-watt incandescent lamps for 55 centimes each (10 cents). The lowest price that has been offered in the United States for equivalent lamps is 18 cents. The manager of the electric light plant states that he can buy wire in Germany at from 10 to 15 per cent. less than in the United States. Referring to the subject of electrical apparatus, the electric light manager, in a letter to the consul, says: "In the country that you represent the major part of the manufacturers of this class of merchandise are sleeping upon their laurels, waiting for orders to come in through commission firms; they do not study the South American market, so as to become acquainted with the requirements of these countries."

Laws of Induction Poetically Expressed.

In an old number of *Blackwood's Magazine* the laws of induced currents were expressed in the following terms:

Around the magnet, Faraday,
Is sure that Volta's lightnings play;
But how to draw them from the wire?
He took a lesson from the heart;
'Tis when we meet, 'tis when we part,
Breaks forth the electric fire.

Theory of Constant Speed, Direct Current, Constant Potential Motors.

BY WM. BAXTER, JR.

There was a time when the theory of constant speed motors was considered to be very complicated, and, in fact, it was sufficiently so then to confuse men who were regarded as high authority upon electrical matters. It is not necessary to go back more than twelve or fifteen years to read any amount of literature in which it is demonstrated by more or less ingenious analysis that a constant speed can only be obtained by means diametrically opposite to those actually required. This, however, is a thing of the past, and writers of the present day rarely make such serious mistakes; in fact they do not attempt to throw away any new light upon the theory, since it is now so well understood, but confine themselves to endeavors to develop formulæ by which the relative proportions of the field coils, etc., may be calculated with greater accuracy. Work in this direction is very useful as mental exercise, but of no more, if as much, practical value than the efforts of mathematicians of old to find a simple geometrical solution of the problem of trisecting an angle. If electric motors were made like bridges, one at a time, it would be of the greatest importance to be able to determine with extreme accuracy the dimensions of all the parts, but even under such conditions any formula that could be developed would not lead to exact results, unless the machine were made upon the same general design as that for which the formula was worked out.

Mathematical investigations can be beneficial, either by reducing the labor involved in making calculations, or by leading to more exact results, but in so far as direct current constant potential machinery is concerned there is certainly no room for improvement in the first direction, and it is very problematical whether there is any in the second.

Within the past year several articles have appeared in the English electrical journals bearing upon this subject. The first was a commmunication in which the author endeavored to increase our stock of knowledge by deducing new formulæ for determining the proportions of field coils for constant speed motors, the others have been criticisms of this, of a more or less unfavorable character. Although the motives of the author and his critics may be commended in the highest degree, it is not probable that their efforts will be productive of results of any special value. It is not difficult to show that it is next to impossible to deduce formulæ not too unwieldy for actual service, that are at all likely to be more accurate than the most simple arithmetical methods.

To maintain a constant speed in a constant potential motor all that is necessary is that the counter E. M. F. divided by the counter E. M. F. developed per revolution be always equal to a constant, which constant is the velocity of the motor. Since the counter E. M. F. is equal to the impressed E. M. F. less the amount balanced by the armature resistance, it follows that as the current through the armature increases the counter E. M. F. reduces, therefore the counter E. M. F. per revolution reduces. If *e* represents the counter E. M. F. and *e'* the counter E. M. F. per revolution, and *r* the armature resistance, we will have

$$e' = \frac{e}{V} = \frac{E - Cr}{V},$$

where *V* is the velocity of the armature; and as this, as well as *E* and *r*, must remain constant, it necessarily follows that *e'* will change inversely with *C*. The whole meaning of this is that the lines of force passing through the armature must change as the current changes, decreasing as the latter increases. A formula for calculating a constant speed motor, that is, the electrical proportions, would resolve itself, therefore, into one for determining the flux through the armature, and to determine this with perfect accuracy is practically impossible, while approximations sufficiently close to answer all requirements can be obtained by very simple methods.

By the aid of the accompanying diagrams the truth of the foregoing can be made quite evident. Consider first Fig. 1, which is a simple diagram of a shunt-wound motor. It is evident that as long as the difference of potential between *A* and *B* remains constant the current through the shunt coil *C* will be constant, and therefore the counter E. M. F. per turn *e'* will not vary. If the armature current changes the variation will be confined to the armature circuit, and the E. M. F. required to force the current through the wire will rise and fall therewith, and the surplus E. M. F. to be balanced by *e' V* will also vary, and as *e'* remains constant, *V*, the velocity of the motor,

must change. Fig. 2 shows this action very clearly. In this diagram the E. M. F. is assumed to be equivalent to the product of a resistance and a current for the sake of simplifying the comparison. Thus the line *A B* is taken to represent the armature resistance *r*, and the line *E B* the imaginary E. M. F. resistance when the current is equal to *E F*. According to this assumption the value of *E* is measured by the rectangle *E D* or any other rectangle of equal area. If the current were one-half of *E F*, *B E* would be twice as long. If it were

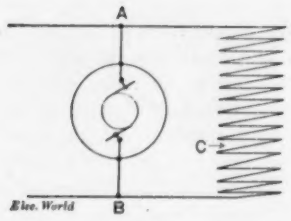


Fig. 1.

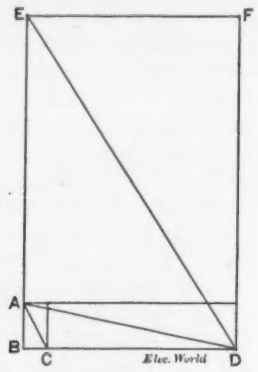


Fig. 2.

reduced to *E G* the vertical line would be correspondingly increased. When the current is reduced to *E G* = *B C*, the E. M. F. balanced by the armature resistance will be equal to the rectangle *A C*, but when the current is *E F* the armature resistance will balance an E. M. F. equal to the rectangle *A D*. In the first instance the difference between the rectangles *A C* and *E D* will represent *e* and in the second the difference between *A D* and *E D* will represent *e*. This diagram shows clearly why it is necessary to make *A B* very small to obtain close regulation in a simple shunt motor, or to obtain closer regulation in a differential wound machine without placing too many turns on the series coils. If *A B* is sufficiently small the rectangle *A D* may be made less than 1 per cent. of the rectangle *E D*, and then the speed of the motor for any current less than *E F* will not be as much as 1 per cent. greater, so far as the variation in *e* alone is concerned, but in consequence of other disturbances it will be somewhat greater.

It is on account of the difficulty of calculating the real value of these outside disturbances that it is next to impossible to determine by calculation the proportions that will give absolute constancy of velocity. If no such disturbances had to be contended with the problem would be very simple, for, as *e* reduces as the current increases, all that would be required would be to pass a current around the magnets in opposition to that in coil *C* (Fig. 1) and have it of such strength that for any value of current through the armature it would reduce the flux to an extent equal to the difference between *E* and *e*. As soon, however, as we begin to investigate the question of determining the number of lines of force passing through the armature we find that we are in a region of uncertainty. We know from numerous experiments that the flux around a current of electricity, surrounded by air, bears a fixed relation to the strength of the current and the length of the magnetic circuit, and we know this relation, if not exactly, at least near enough for all practical purposes. When we surround the current with iron our knowledge ceases to be so accurate, and it is still less so if the magnetic path is part iron and part air. We can construct an iron ring and by passing a current around it ascertain the relation between the ampere turns and the density of the flux, but this relation will not hold good for any other ring, except by mere chance. The difference will not be great if the rings are made of the same quality of iron, in fact unless there is considerable difference in the metal the magnetic properties will be substantially the same, but not equal. If we cut a piece out of the ring the relation between flux and current will at once be changed, and the change will depend not only upon the amount of iron removed, but also upon the shape of the piece. If we calculate the flux by making proper allowances for the air gap introduced into the magnetic circuit we can obtain results not very far removed from those obtained by an actual test, but they will not be in perfect accordance with them. If we make an actual test, and then file off the corners of the iron where the piece has been cut out, a second test will show that in consequence of the filing the results have been changed. If the magnetizing coil is spread all over the ring the flux across the air gap will be greater than if it is bunched at one point, and the position at which the wire is concentrated will also affect the flow of lines across the air gap.

The foregoing actions are due to the fact that iron, of itself, is inert, and that its only effect when in a magnetic circuit is to reduce the resistance thereof, consequently the lines of force will follow it just the same as an electric current will follow a copper wire instead of passing through a surrounding medium of lower conductivity. All the magnetic flux, however, will not pass through the iron; a part

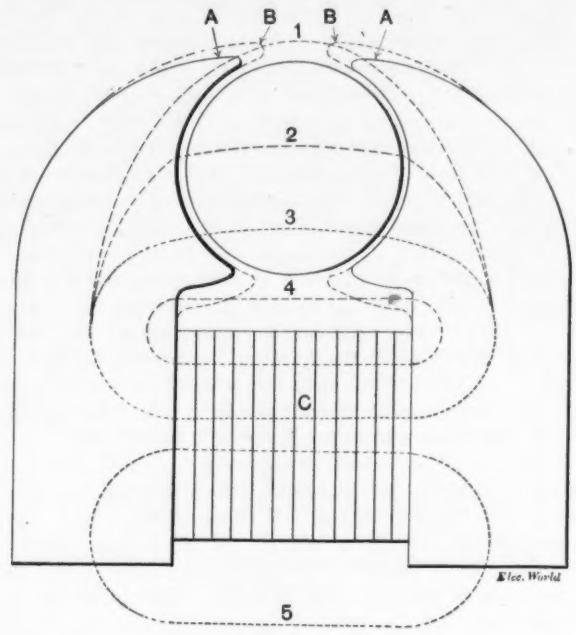


Fig. 3.

will go through the air, the relative proportion following each path being dependent upon the relative resistance. To illustrate these points, and to show the difficulty of calculating the flux through the armature of a motor, we will consider Figs. 3 and 4.

Fig. 3 represents the type of bipolar machines in which the field is magnetized by a single coil, and Fig. 4 the variety using two coils. We might increase the list by adding those using four and more coils, but these two examples are sufficient for our purpose. If the

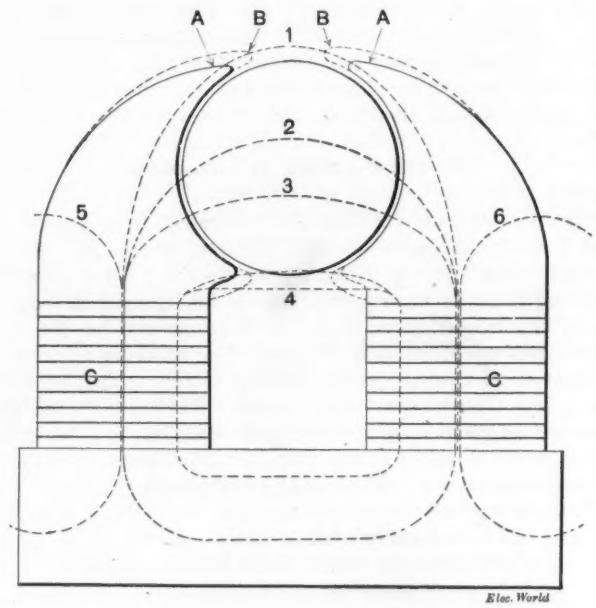


Fig. 4.

coil in Fig. 3 were removed from its present position the flux around it on all sides would be about as indicated by the line 5, and the flux of the two coils in Fig. 4 would be as indicated by the lines 3, 5 and 6. When the coil is placed around the iron core the greater conductivity of the latter causes the greater part of the magnetism to pass through it, but there will still be a certain amount of flow through the paths 5, in Fig 3, and 5 and 6 in Fig. 4. The number of lines of force passing through these paths, external to the armature, will depend upon the length of the coil, upon the configuration of the

iron on either side of it, upon the total length of the magnetic circuit, upon the width of the air gap between the armature and the pole pieces, upon the density of the flux through the armature, and upon a number of other conditions. From this it can be seen that a formula that would enable us to determine with certainty the leakage along the lines 5, Fig. 3, and 5 and 6, Fig. 4, would be very cumbersome, because it would have to be burdened with factors to represent these leakages, and, as can be realized from the foregoing, these factors would really resolve themselves into complicated terms, provided with a sufficient number of variables to represent all probable changes, geometrical and magnetic. This complication would only be the beginning of our trouble, however, for we would then have to consider the route taken by the flux passing by way of the armature circuit. If all the lines in that direction passed through the armature the calculation would be considerably simplified, but such is not the case; part will pass above the armature, as shown by line 1, and part will pass below it, as shown by line 4. These, then, are other leakages we must provide for in the formula, and for their proper repreesntation we would have to introduce complex terms. If the corners of the pole pieces were far apart, as shown at *A A*, the leakage would be less than if close together, as at *B B*. Their shape would also affect the leakage, and variations in the density of the flux through the armature would again vary the relation. The leakage across the upper side would not be the same as that at the lower side, hence the complication of the formula would be still further increased. These only show a few of the difficulties to be contended with. The variable effect of armature reaction due to variations in current, the effect of eddy currents, etc., etc., all serve to render it an almost superhuman task to calculate their value with accuracy. In a purely theoretical discussion these complications need not come to the surface, as we can take *A B C*, etc., to represen the leakages along the lines 1, 4, 5, and *D*, *E*, *F*, etc., to represent other losses. When we get down to an actual application of the formula we must substitute for these simple symbols the complicated expressions they represent, and the handling of these may involve an amount of labor that only the most industrious mathematician would care to undertake. This is well illustrated by the difference between the general discussion of the development of a function and the actual development thereof. In the first instance we can write the terms of the series in the form $A + B x^n + C x^b + D x^c, \ldots$ but in the second we must give the terms their true value, which will involve far more labor than the simplicity of the general form would indicate.

There are many men who overcome such difficulties by jumping over each one with the assistance of an assumption, but when this course is pursued the mathematical accuracy aimed at is departed from. If assumptions are introduced to surmount difficulties here and there, why not lump these difficulties and make one assumption to cover the whole, and thus simplify the calculations to such an extent as to render unnecessary even the most elementary mathematical work?

Since with very rare exceptions machines are manufactured in large numbers from the same patterns, it must be quite evident that the best way to obtain the proper proportions for the field coils is by actual trial. The course of procedure that in practice will require the least expenditure of time, money and effort will be about as follows:

Calculate the ampere turns required to pass through the armature the flux necessary to develop the desired E. M. F., an allowance being made for the leakage along the lines 1, 4 and 5, and for other losses. An attempt may be made to calculate in a rough way what this allowance should be, but experienced designers generally would prefer to rely upon their judgment. The proportions of the various parts, as well as the outlines of the machine, should be made so as to reduce these losses to the lowest point. When the ampere turns required in the field coils have been determined the space allotted to these should be made large enough to allow an increase of anywhere from 10 to 25 or 30 per cent. in the coil cross section. When the first machine is ready for trial it should be provided with a temporary coil on the field, this being supplied with current from a source independent of that used for the armature. The number of turns in the coil being known, the ampere turns can be ascertained if an ammeter is placed in the circuit. The armature is connected with a source, the E. M. F. of which is equal to that at which the machine is intended to run, and the current through the field coil is increased or decreased until the proper speed is attained when the motor is running free. Then the full load is thrown on and the field current again measured. In this way the ampere turns required in the field coils are ascertained with certainty, and the construction of the permanent coils becomes a very simple matter. To illustrate, suppose it is found that the ampere turns required when the motor is running light are 6000, and when the full load is put on they are reduced to 5450, and that the current through the armature, running light, is five amperes and fifty when loaded. From this we would see at once that the ampere turns in the shunt coil would have to be 6050, and that the series coil would require ten turns; for then, with the full load the ampere turns in the series coil would be 500, and this deducted from 6050 would leave 5450—the number found to be necessary at full load. With the light load, as the armature current would be reduced to five amperes, the ampere turns in the series coil would be fifty, which deducted from the 6050 of the shunt coil would leave 6000, as required when running light.

This method might be sneered at by those of strong mathematical tendencies, as it belongs to the rule of thumb family, but any designer who is not possessed of an unreasonable amount of confidence in the reliability of his mathematical work would feel that there was a reasonable amount of doubt as to the absolute correctness of his calculations, and if guided by ordinary prudence would conclude to follow the course that would involve the least expenditure. This would be to make the first trial with an experimental coil, which could be made of a few turns of large wire. If he desired to gratify his curiosity and ascertain how near he had come to hitting the mark in his calculations he would probably finish the machine with shunt and series coils, as per calculations. In nine cases out of ten he would come quite near to the mark, but would not hit the bull's eye, and as a result would be compelled to rewind the field, and would, therefore, be no better off than if he had used the rule of thumb method. Financially, he would not be so well off.

In nearly all the literature relating to constant speed and constant potential machines a great deal is said about the number of turns of wire in the shunt coils, and even when the number of ampere turns are spoken of, these and the turns of wire are so mixed up that those not familiar with the subject are not liable to suppose that exactness in one case is as essential as in the other. Now, as a matter of fact, the number of turns of wire in the shunt coils have very little to do with the regulation of the machine, and would have nothing whatever to do with it if all the turns in the coil were of the same length. As can be clearly seen, if all the turns were of the same length doubling the number would double the resistance and therefore cut the current in half, since the difference of potential between the ends of the coil would remain the same. Twice the number of turns with half the current in the wire gives the same number of ampere turns. If the difference between the inner and outer diameters of the coil is not great the number of turns of wire can be considerably increased without materially changing the ampere turns. Suppose the inside diameter is 10 inches and the outside 12, which would make the winding 1 inch deep. The average length of a turn would then be about 34.55 inches. If the depth of the winding were increased to one inch and a quarter, giving 25 per cent. more turns of wire, the average length of the turns would be increased to 35.34 inches, a difference of about 2 per cent; hence the ampere turns would be reduced about 2 per cent. by increasing the turns of wire from 20 to 25 per cent. The number of turns of wire affects the efficiency of the machine, as it varies the amount of current passing through the shunt coil; the greater the number of turns the less the energy used to magnetize the field.

The ampere turns depend upon the cross section of the wire, or, in other words, its gauge number, and this can be determined by a very simple rule, which the writer has not seen published, although most designers have no doubt found it out in the course of their experience. It is based upon the elementary principle of Ohm's law, that one volt will pass a current of one ampere through one ohm. If the ohm is a wire 200 feet long, one volt will give a current of one ampere 200 feet long, so to speak, and the number of ampere turns will be equal to the number of turns into which this length of wire is coiled. For each additional volt the number of ampere turns will be increased a like amount. Calling the ampere turns *T*, the feet per ohm the wire will measure *F*, the average length in feet of a turn in the coil *L*, we have the four following equations:

$$(1)\quad F = \frac{TL}{E} \qquad (2)\quad T = \frac{FE}{L} \qquad (3)\quad L = \frac{FE}{T} \qquad (4)\quad E = \frac{TL}{F}$$

From the first we can get the feet per ohm the wire should be to obtain a given number of ampere turns, when the voltage and average length of a turn have been decided upon. From the second we can get the number of ampere turns obtainable with a given size

wire, the voltage and length of turns being known. The third gives the average length of a turn that will give the desired ampere turns, with a given size wire and voltage. The fourth gives the voltage required to obtain the desired ampere turns with a given size of wire and length of turn.

The standard sizes of wire differ from each other in resistance by about 25 per cent., and in most cases a regular size will not give the exact number of ampere turns required. In such cases the proper amount can be obtained by using the two sizes between which the true size lies, in such proportion as to give the resistance called for. A small discrepancy can be adjusted by varying the number of turns of wire in the coil, but, as has been shown, only a slight change can be effected in this way, unless the depth of the winding is sufficient to make the outside diameter of the coil 40 or 50 per cent. greater than the inside.

Re-inspection of Electrical Fire Risks.

BY J. E. TALBOT.

It is an undoubted fact that the electric current when properly installed affords the safest means known at present for illumination, but it is also true that such an installation, if carried out with parsimonious ideas in the ascendant, is a source of danger, and, to a greater or less degree, threatens a conflagration at all times.

In the present condition of the art this statement is a truism, and only reiterates what is perfectly well known.

It might also be supposed that with the supervision now exercised by various authorities over the work of installation that defective wiring or appliances could hardly be found to-day.

Construction work is most certainly much better, as a rule, in 1897 than it was in 1887, though no rules and no inspection can entirely eliminate the dangers due to cheap work.

It is not, however, to the class of work done at the present day to which I would call attention, but rather to old work, which may or may not have been passed by an inspector, and to alterations and additions which in many cases have never been passed by anyone, except as their dangers have been passed unnoticed or unheeded. So long as no actual trouble arises the average owner of property is very apt to suppose that everything is all right, and to pooh-pooh any suggestion that money should be spent, on the ground of safety.

Nevertheless every electric light man is continually meeting cases where the conditions, if not absolutely dangerous for the moment, are liable to become so on the least provocation. A nail carelessly driven or even the upsetting of a pail of water or a bit of leaky plumbing might cause a loss of thousands of dollars. Instances of this will occur to everyone of us, so one example will suffice. Within the past few weeks the writer happened to be on the stage of a well-known theatre in an Eastern city, where, instead of a switchboard of slate or marble, constructed with a view to safety, there was a beggarly asortment of switches of various kinds, wires running hither and thither, and rags of perished tape dangling about, the whole attached to a wooden partition at the back of the boxes. The circuits were overloaded, and the whole thing dangerous. In another case of old work, also in a theatre, in the West, —anything but a fireproof structure—wired with "undertaker's" wire, joints were found, with no solder, of course, the two ends of the wire just hooked together, and apparently only kept in contact by the tape wrapping.

Now, without being an alarmist, no one can regard conditions such as these without considerable apprehension. In the event of trouble occurring, not only is there the particular case of damage to be considered, but also the moral effect on the public mind. The public is ready enough to accept the dictum of some irresponsible reporter that "the fire was caused by electric wires"—even in cases where there may have been no current in the building at all. Where defective work causes injury the virtuous suffer more than the guilty, and the whole electrical business feels it.

I am not claiming that anyone is responsible for work remaining in a condition which is dangerous or which may readily become so. It is suggested, however, that some authority should be made responsible, being supported by due legal powers.

The Commissioner of Wires for Boston, in connection with this subject, says in his last report: "There are miles of wire concealed from view that were installed before the creation of this department, the insulation and method of installing of which would not have received its approval, and the inroads of time on such installations will gradually cause them to become an element of danger. For this reason fires due to the transmission of electricity, must be expected in the future, which this department is powerless to prevent."

In view of the existing state of affairs, it would seem not unreasonable to have all electric installations subject to re-inspection under the law, at stated periods, for the public protection, or, if this seemed too harsh a measure, let the compulsory revision be confined to public places, such as theatres, halls, large office buildings, churches and the like, leaving the insurance companies to protect their own interests by refusing to renew policies unless suitable changes are made.

It is unnecessary to say that the insurance companies are unwilling to lose business through an excessive scrupulousness in such risks, and frequently the agent renewing the policy has not sufficient technical knowledge to judge what conditions are dangerous and what are not. Should the insurance interests insist on a proper re-inspection of all electrical risks from time to time, still tact and discrimination could be employed with advantage in deciding in which cases radical alterations or reconstruction must be required to avoid imminent danger.

It is suggested also that the insurance companies, by making a liberal reduction on their rates for electric lighting executed in a first-class manner, would stimulate owners to pay for good work. Statistics will show the relative fire danger of the electric light as compared with gas, oil or candles, with their necessary adjuncts—matches.

Owners of property are by nature averse to spending money, but a little judicious pressure from insurance interests would at least render them willing to approximate in their electric equipment the standard they recognize with regard to gas, water and plumbing. For present and future work the ever-improving standard of construction may be relied on.

In the case of places of public resort, where a panic would be disastrous, the rules can hardly be too stringent, and it is believed that no one would welcome these more heartily than the electrical fraternity.

The New Telegraph Cable to Hayti.

In a communication to the State Department from Samuel Proskauer, United States Consul at Puerto Cabello, Venezuela, that gentleman states that the recent completion of the telegraph cable line from that place to La Guayra, thence to Curacoa, Hayti and other places, to New York, has proved of great service to the merchants of Puerto Cabello. Formerly messages passed over the national telegraph line to Caracas, thence to La Guayra, often causing delay of many hours, not infrequently days, and sometimes giving imperfect service. The reliability of the new route has been productive of its more frequent use, and merchants cable orders to New York for goods have increased. It is believed that the service from Coro will be in operation shortly.

Twenty-fifth Birthday of the London "Electrical Review."

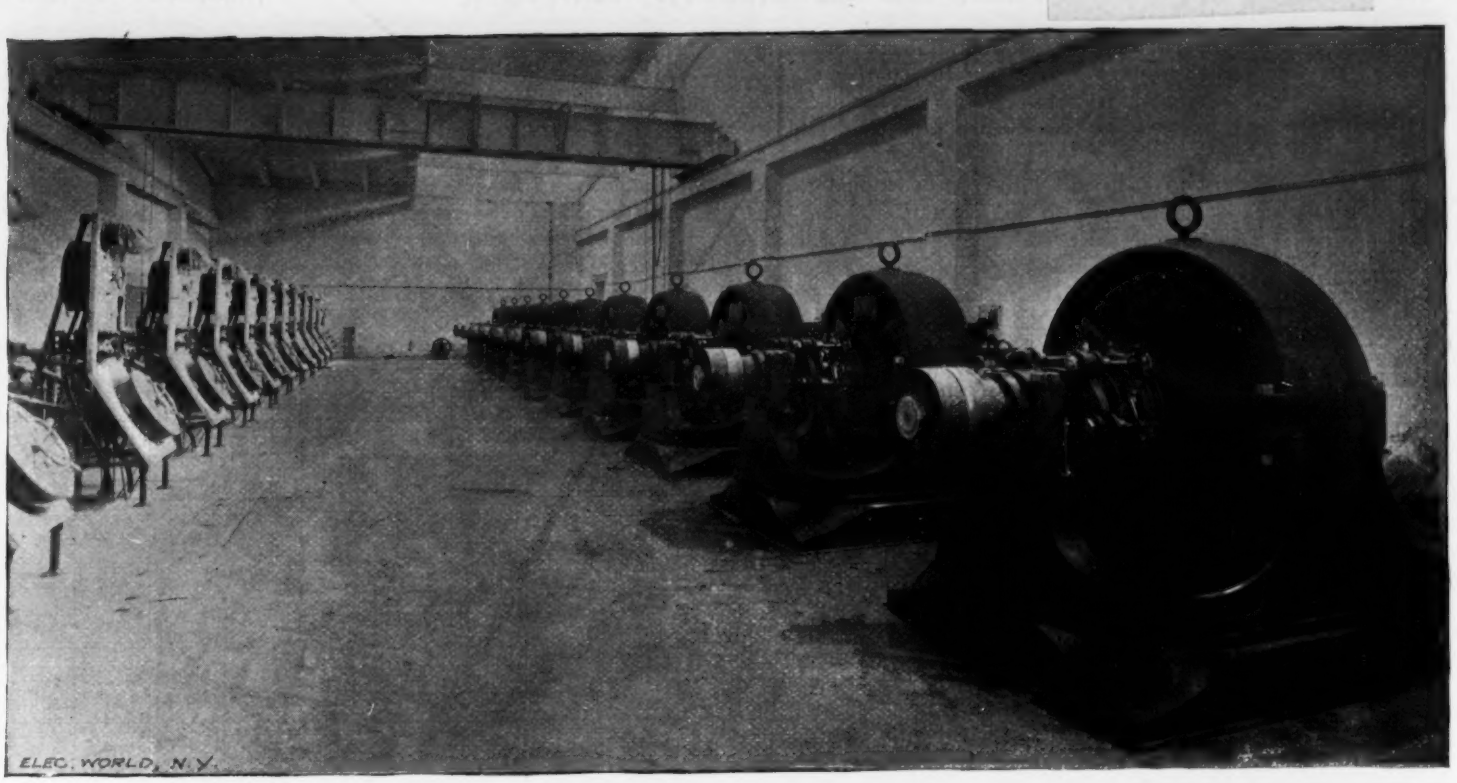
Our contemporary, the *Electrical Review*, of London, celebrated the twenty-fifth anniversary of its first appearance by making its issue of November 12 a specially attractive number. The special feature of this issue is a large number of special articles by prominent writers in each department, describing the evolution during the last twenty-five years of incandescent lighting, dynamo electric machinery, secondary batteries, electrical instrument making, electro-chemistry, boiler making, arc lighting, telephony, traction, etc.

Buying More Stock in the Walker Company.

A telegram from Cleveland says that the Eastern capitalists, including ex-Governor Flower, Major J. W. Hinkley, Anthony N. Brady and Perry Belmont, who some little time ago bought a block of stock of the Walker Company, of Cleveland, have now purchased the entire property of the Walker Company, including all the stock and bonds. This, however, is not likely to make any change in the management of the company.

Ill-Mannered Lightning.

From Muncie, Ind., comes the interesting bit of information that during a recent heavy rainstorm there "lightning knocked hundreds of people right and left, but none were seriously hurt."



GENERAL VIEW OF TRANSFORMER ROOM.

The Electrical Equipment of the Mathieson Alkali Works.

BY J. R. HASKIN.

The district surrounding the great power house of the Niagara Falls Power Company is rapidly being covered with large and substantial factory buildings, where processes requiring large amounts of power are being applied commercially.

The plants of the Carborundum Company and the Pittsburg Reduction Company were the first on the ground, while the latest addition, and at the same time one of the largest, is the works of the Mathieson Alkali Company. This company has heretofore carried on its work in Saltville, Va., making bleaching powder and various other chemicals.

This article will not attempt to describe the chemical processes or the details involved in the work, but will give a few facts concerning the electrical machinery.

The entire electrical equipment has been supplied by the Westinghouse Electric & Manufacturing Company, and makes a very striking appearance.

The transformer room is 125 feet long and 40 feet wide, and adjoins the cell room on the north side, extending the whole length of the latter, and separated from it by a brick wall.

In the main room the cells, extending in uniform rows north and south, are connected up in ten separate sets. Corresponding to these sets and installed in a long line in the transformer room are eleven rotary transformers, each converting 200 horse-power from about 120 volts alternating to about 200 volts direct current.

These rotaries are of the regular Westinghouse standard type, and are similar to a number of others which are being operated in the factories located in the adjoining power district.

This long line of machines, each one a repetition of the other in every detail, presents quite an unusual sight. Three uniform

STATIC TRANSFORMERS AND REGULATORS.

lines extend the length of the room, the static transformers forming one, the switchboards in front of them another, and on the opposite side of the room the rotary transformers form the third.

Through them 2000 horse-power is converted from 2200 volts alternating, at 25 cycles, to about 200 volts direct current.

While it is necessary to keep the voltage proportional to the number of cells in use, the means provided are ample, as the controllers, which form part of the electrical equipment, give a range of 100 volts on the direct current side of the rotaries. As shown in the illustration, the controllers are mounted on the switchboards, which extend in a line along the north side of the room. On these boards are mounted also the instruments, field rheostats, main primary switches and fuse boxes. It may be mentioned that the function of the controllers is to vary the pressure supplied to the rotaries by cutting in or out sections of the primaries of the static transformers. These latter are installed to the rear of the switchboards, each set consisting of two 100-hp transformers, which step down the pressure from 2200 to from about 170 to 300 volts.

On the opposite or south wall are installed the main switches and circuit breakers, which control the direct current supplied to the cell room.

This completes the description of the main power units, and a few words will dispose of the remainder of the electrical equipment, which consists of twenty two-phase induction motors. They are used for a number of purposes, some furnishing power for the machine room, which is very completely supplied with lathes, drills, etc., used in making up the cells and other parts of the electrolytic equipment. Others are used in the process and to drive blowers, cranes and pumps, while two are mounted on hand trucks to be used in starting up the rotaries.

This brings us to a novel method of starting up the machines, and one which has not heretofore been used in this district. Each rotary is supplied with a 10-inch pulley and an idler, the armature shaft being prolonged beyond the bearing of the alternating current end for this purpose.

It was intended, when starting up the plant, to pull one of the small motors, mounted on a hand truck, into proper position, belt it to the rotary, and in this way get the latter up to synchronism, the operation being repeated with each rotary in order to get the plant running. But after getting the first machine started, the idea immediately suggested itself to the engineer, Mr. Max Mauran, of using this rotary as a motor, and belting it to the next machine in the line, this operation being rendered easy by the idlers being mounted on the ends of the shafts. The method has been found to work so well that the whole plant has been started from a dead stop in fourteen minutes. This, of course, does not include throwing in the direct-current switches.

With machines of this size the operation is a very easy and simple one, besides saving a great deal of time in synchronizing, as the slipping of the belt is just sufficient to give enough variation in speed to cause the rotary to synchronize every five to ten seconds.

This is only one of the very many practical ideas that are constantly being met with in the power district. Where, however, new wants are to be found in every factory, and the whole problem differs from any previously undertaken, it is no wonder that old ways and methods are being improved upon or totally superseded with better ones.

Alternating-Current Machinery—XXI.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

COMPOSITE E. M. FS.

177. We have hitherto considered that the E. M. Fs. acting on a circuit were of the simple alternating or sinusoidal type, a condition which, strictly speaking, can only be approximately true in practice. We may next consider in what respect the removal of this limitation affects alternating-current circuits.

In the continuous-current circuit we know that if two continuous E. M. Fs. of $+e_1$ and $+e_2$ volts, respectively, co-act, the total E. M. F. in the circuit will be $+(e_1+e_2)$ volts.

In a simple alternating-current circuit, if two co-periodic E. M. Fs. co-act, of E_1 and E_2, effective volts, respectively, where E_1 and E_2, are plane vectors, or complex quantities, the total effective E. M. F. will be $+(E_1+E_2)$ volts, the summation being effected geometrically, and not arithmetically. This will be true whatever the phase difference between E_1 and E_2, provided that both have the same frequency. (Sec. 70.)

178. If we combine in one circuit of total resistance r ohms, and total inductance l henrys, a continuous E. M. F. of e volts with a simple alternating or sinusoidal E. M. F. of e_a volts effective (which is capable of being expressed as $\sqrt{2}\,e_a \sin \omega t$ volts (Sec. 53)), the resulting combined E. M. F. may be expressed as $(e+\sqrt{2}\,e_a \sin \omega t)$ volts, at any instant t seconds after a moment at which the alternating E. M. F. is zero and increasing positively. Thus, Fig. 126 shows the total E. M. F. obtained by impressing upon a single circuit a continuous E. M. F. of 50 volts effective and a simple alternating sinusoidal E. M. F. of 7.07 volts effective, or 10 sin 120 π t volts, as represented separately in Fig. 127. The resultant E. M. F. $E = (50 + 10 \sin 120\ \pi\ t$ volts) pulsates sinusoidally between 60 and 40 volts, with a frequency of 60 cycles per second. It might be supposed that since the arithmetical mean value is 50 volts the effective value is 50. If, however, we take the square root of the mean square of the E. M. F., E, in Fig. 126, we find that the effective value is 50.498 volts, or nearly 50.5, and this is the pressure

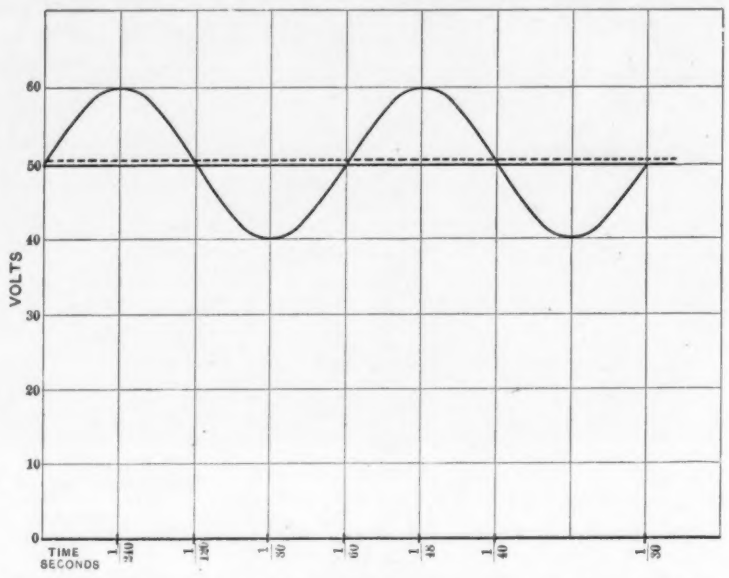


Fig. 126.—Combination of a Continuous and an Alternating E. M. F.

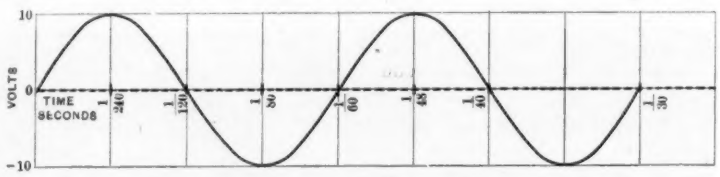


Fig 127.—Sinusoidal E. M. F. 10 Sin 120 π t Volts.

which would be indicated on a voltmeter connected in series with a steady pressure of 50 volts and a sinusoidal alternating pressure of 7.07 volts effective. The rule for determining the resultant effective E. M. F. is given by the equation

$$E = \sqrt{e^2 + e_a^2} \text{ volts,}$$

or the effective combined E. M. F. is the square root of the sum of the squares of the continuous and alternating effective E. M. Fs. This is represented in Fig. 128, where OA represents 50 volts of continuous pressure, AB the alternating effective pressure of 7.07 volts, and OB the effective resultant pressure of 50.5 volts, OA, AB, and OB, forming the sides of a right-angled triangle.

179. Similarly if i be the strength of current sent through the circuit from the continuous E. M. F., considered as acting alone, from the relation $i = \frac{e}{r}$ amperes, and i_a be the effective strength of alternating current sent through the circuit from the alternating E. M. F., considered as acting alone from the relation $i_a = \frac{e_a}{z} = \frac{e_a}{r + j\,l\,\omega}$ amperes effective, the total current flowing at any in-

stant will be $i + i_a$ amperes, or $i + \sqrt{2}\, i_a \sin \omega t$ amperes, and the effective value of this as shown by an ammeter will be

$$I = \sqrt{i^2 + i_a^2}$$

or will be represented by the hypothenuse of a right-angled triangle whose sides are proportional in length to the continuous and alternating effective currents, respectively.

180. For example, if the resistance in the circuit of the E. M. F. represented in Fig. 126, were 10 ohms, and the inductance 0.05 henry, the continuous-current strength would be

$$i = \frac{50}{10} = 5 \text{ amperes.}$$

The impedance of the circuit to a frequency of 60 cycles per second would be

$$\begin{aligned} Z = r + j\, l\omega &= 10 + j\, 0.05 \times 2\pi \times 60 \\ &= 10 + j\, 0.05 \times 377 \\ &= 10 + j\, 18.85 \\ &= \sqrt{100 + 355.3} \\ &= 21.34 \text{ ohms.} \end{aligned}$$

The effective alternating-current strength considered alone is therefore

$$i_a = \frac{7.07}{21.34} = 0.3313 \text{ ampere effective.}$$

The effective resultant current strength in the circuit is, therefore, $I = \sqrt{5^2 + (0.3313)^2} = 5.011$ amperes, or very slightly in excess of 5 amperes. When, therefore, a continuous and an alternating E. M. F. co-act upon a single circuit, each E. M. F. sends a current, and each develops its own activity in the circuit as though the other did not exist. But the resultant effective pressure is the square root of the

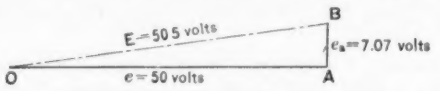


FIG. 128.—DIAGRAM SHOWING THE RESULTANT E. M. F. DUE TO THE COMBINATION OF A CONTINUOUS AND ALTERNATING E. M. F.

sum of the squares of the effective continuous and alternating pressures, and the resulting effective current is the square root of the sum of the squares of the effective continuous and alternating currents. From the standpoint of power the two are independent. On the average, the continuous-current source does no work upon the alternating current, and, in the same way, on the average, the alternating-current source does no work upon the continuous current, although within the limits of a single cycle there will be an interexchange of power betwen the two sources, the continuous pressure driving the alternating current and then opposing the alternating current in the two halves of each cycle.

181. Similarly if two non-co-periodic sinusoidal E. M. Fs. co-act upon a circuit, each will send a current as though the other did not exist. Thus if the E. M. Fs. be e_1 volts effective (or $e_1 \sqrt{2} \sin \omega_1 t$ volts at any time t seconds from some instant at which e_1 is zero and increasing positively), and e_2 volts effective, or $e_2 \sqrt{2} \sin (\omega_2 t + \alpha)$, the two angular velocities ω_1 and ω_2 being different, and corresponding to different frequencies, then the current sent through the circuit will be $I = \frac{e_1}{Z_1} + \frac{e_2}{Z_2}$ amperes at any instant, or

$$I = \frac{e_1 \sqrt{2} \sin \omega_1 t}{r + j\, l\, \omega_1} + \frac{e_2 \sqrt{2} \sin (\omega_2 t + \alpha)}{r + j\, l\, \omega_2}.$$

So that each E. M. F. delivers its current through the circuit against the impedance developed to its own frequency, and the total current at any instant is the sum of the two separate currents. The constant α is the relative phase-difference, expressed in seconds, existing between the two E. M. Fs. at the moment when $t = o$.

The effective E. M. F. of the combination will be

$$E = \sqrt{e_1^2 + e_2^2}$$

or the square root of the sum of the squares of the component effective E. M. Fs. and the effective current strength of the combination will be

$$I = \sqrt{i_1^2 + i_2^2}$$

182. Thus if a simple alternating E. M. F. of 100 volts effective, at a frequency of, say, 110 ~, be connected in series with another simple alternating E. M. F. of 100 volts effective, at a frequency of, say, 133 ~, the combined effective E. M. F. of the two will be

$$E = \sqrt{100^2 + 100^2} = 141.4 \text{ volts effective.}$$

Similarly, if the current strength in the circuit due to the first E. M. F. is 1 ampere, while the current strength due to the second E. M. F. of the higher frequency is, say, 0.9 ampere, the total effective current strength, as shown by an ammeter in the circuit would be

$$I = \sqrt{1^2 + 0.9^2} = 1.345 \text{ amperes.}$$

The two E. M. Fs. would, on the average, do no work upon each other, and so far as average power is concerned would be independent.

183. In the same way, if a number of simple alternating E. M. Fs. of different frequencies co-act in series upon a circuit, each will develop its own E. M. F. as though the others were not present, and each will send its own strength of current through the circuit as though the others were not present. The total effective E. M. F. of the combination will be

$$E = \sqrt{e_1^2 + e_2^2 + e_3^2 + \ldots} \text{ volts,}$$

where $e_1\, e_2\, e_3$, etc., are the separate effective E. M. Fs. The total effective current strength in the circuit will be

$$I = \sqrt{i_1^2 + i_2^2 + i_3^2 + }$$

where $i_1 = \frac{e_1}{Z_1}$; $i_2 = \frac{e_2}{Z_2}$; $i_3 = \frac{e_3}{Z_3}$ effective amperes, so that each component current is such as would be sent through the circuit if all the other E. M. Fs. were suppressed, without otherwise altering the circuit. The impedance would differ with each frequency.

The drop of pressure at any point of such a circuit could be determined by finding the drop for each current and summing the different values by the same rule.

184. It will be seen, therefore, that the rule for combining a continuous E. M. F. with a sinusoidal E. M. F. is the same as that for combining two sinusoidal E. M. Fs. of different frequencies; or, in other words, a continuous E. M. F. behaves in a composite circuit like a simple alternating E. M. F. of a particular frequency, namely, zero.

The Proper Construction and Uses of Economizers.*

BY HENRY G. BRINCKERHOFF.

The principle of heating the feed water in a separate vessel, quite apart from the boiler, and thereby utilizing the heat in the waste gases, is the function of flue heaters, more commonly called "economizers," leaving the boiler to supply chiefly the heat units necessary for the latent heat of steam. Taking the important steam users throughout the world, this is a recognized and universally adopted practice. Economizers are not only considered a necessary part of the equipment of every steam plant in Great Britain, but are in operation all over the Continent, and well known in the spinning mills of Russia and India; equally noted among the gold mines of South Africa and the textile factories of China and Japan; while throughout the large manufacturing districts of the United States they are already extensively adopted.

The great loss of fuel as noted between the heat value of coal and the heat taken by the water has been observed for many years, and numerous have been the appliances to recover it, the simplest and best method appearing to be to pass the waste gases on their passage to the chimney through pipes containing water, and thousands of such pipe heaters have been constructed by nearly as many makers, yet with an exception of one or two they have all failed. Disappointment has attended the result of so many economizers or flue heaters, that we find that some people have become skeptical and condemn them all, and state it to be impossible to build one which will last and give satisfactory results.

The failure of so many flue heaters is attributed to three causes:

First: Not being made of cast iron, the only practical metal to withstand the corrosive action of sulphurous gases.

Second: Lack of capacity. It takes time to absorb enough heat to make them of practical value, hence the water should be from thirty to fifty minutes surrounded by waste heat.

Third: Lack of automatic cleaning of pipes. Soot being a nonconductor of heat, a slight coating on a limited capacity economizer would end its usefulness in a few hours after it had been thoroughly cleaned.

Briefly stated, the further and most important details for a well-designed economizer should be the absence of all "made" or packed joints inside of the brick work.

*Extracts from a paper read at the Philadelphia meeting of the New England Cotton Manufacturers' Association, October, 1897.

Second: Easy accessibility to every square inch of internal surface.

Third: The vertical pipes should be forced into the top and bottom headers by powerful hydraulic pressure, making the joints metal to metal, which is a far superior piece of workmanship than fitting the pipes loosely into the boxes or headers and then rusting in by the use of iron filings and sal ammoniac.

Finally, applying a rigid test to each section of 350 pounds to the square inch.

A well-constructed economizer built under the specifications described should last twenty years under ordinary care and attention. After it has reached that age it can be easily repaired and parts renewed so as to last indefinitely, as an umbrella retains its original individuality which has been fitted with new stick, spokes and recovered.

The care required consists in blowing off daily at the same time as the boilers. Every three months the soot should be cleaned out of the chamber below, which at such an interval is about an hour's job. Once a year, at least, the caps should be taken off and the interior of the pipes inspected. If the water is bad this should be done oftener. There is no reason why the scraper mechanism should not run smoothly for years. This used to be a troublesome point with some of the early makes of economizers.

The general use of compound condensing engines in modern steam plants has enlarged the field and extended the use of economizers, as the exhaust steam is not available for heating feed water except to a limited degree.

A common practice some years ago was to take a portion of the exhaust steam for heating feed water, obtaining thereby a temperature of about 210°, while with the compound-condensing engines it is not generally feasible to get much over 130°, thus making a direct loss in economy for the compound plant, as compared with the older ones, to the extent of 7 to 10 per cent. of all coal consumed, offsetting by that amount the gain obtained by compounding, whereas the higher temperature of the steam demands a higher temperature of feed water, instead of lower, for the proper efficiency and durability of the boiler.

The advantages of the economizer may be summarized as follows:

First: It effects a saving of fuel by recovery of heat otherwise totally lost.

Second: It increases the capacity of the boiler plant.

Third: It saves repairs to the boilers by relieving them of much of the strain of expansion and contraction caused by colder water entering the boilers and mingling with the hotter contents.

Fourth: It prolongs the life of the boilers for the same reason.

Fifth: It saves much cleaning of the boilers, thereby increasing their inefficiency because of the precipitation of feed water impurities in the economizer, many impurities not being freed from the water until a high temperature is reached. This fact, and the slow movement of water in the economizer, is the reason that this apparatus removes so much more foreign matter from the feed than the other types of heaters.

Sixth: The economizer is especially desirable where the work fluctuates. A large amount of power suddenly withdrawn drops the boiler pressure, while fresh coal in the furnace and cold feed water entering the boilers make matters worse, a condition frequently observed in bleacheries and electric plants. Gauge pressure is seldom observed to drop when an unusually large amount of feed water is being forced into the boiler, where it has been previously heated in an economizer.

Seventh: Any use hot water can be put to in process of manufacture can be obtained free of cost by drawing the pure hot water from the economizer; particularly bleachers and dryers take advantage of this opportunity for their keirs and dye tubs. Where mills are heated during the winter by hot water a part of the economizer can be included in the circulating system, supplying the heat necessary entirely by the waste gases. This has been done by some large mills, the Grosvenor-Dale Company, a good representative of our New England textile mills, being one of them.

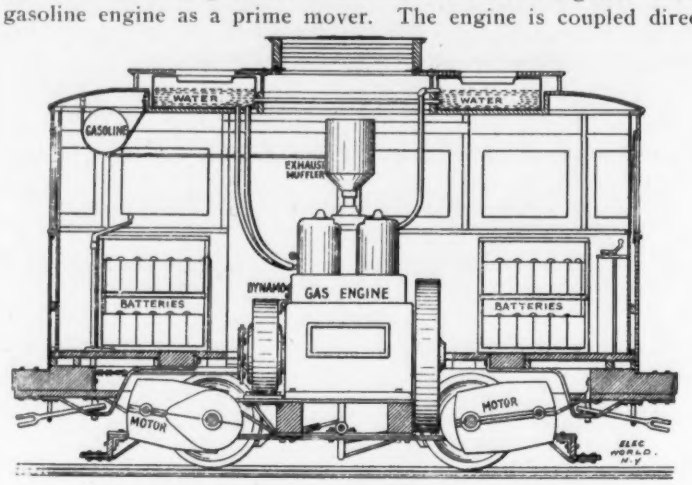
In conclusion, I may say, it is the general opinion of those owning economizers, and others having them in charge, that it makes easy working conditions in the boiler room.

Failed to Find the Cable.

A dispatch from Calais, France, on November 18, states that the steamer Silvertown, which was dispatched to recover the end of the French-American cable, which was buoyed in deep water, has returned to that place, having failed to find the buoyed cable.

The Patton Motor Car.*

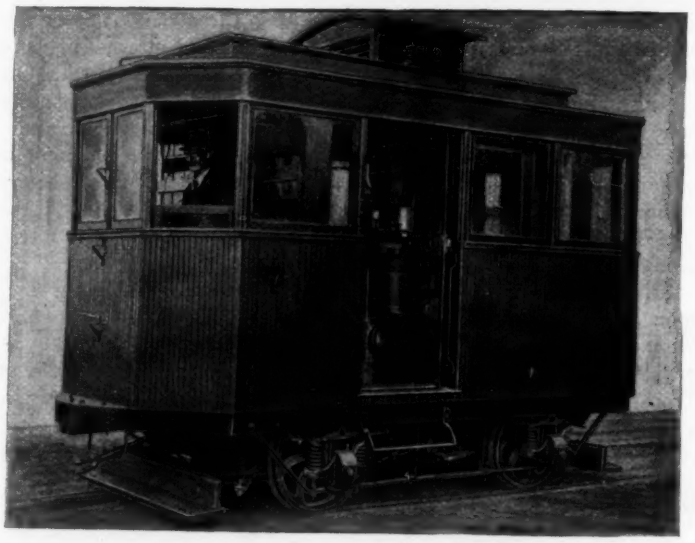
An automobile car with self-contained prime mover and electrical transmission system, resembling in some respect the Heilmann locomotive, has been developed by Mr. W. H. Patton, and experimented with on the street railways of Chicago and other Western points. The striking feature of this car is the use of a gas or rather gasoline engine as a prime mover. The engine is coupled direct



Schematic Elevation of Car.

to a dynamo, which supplies power to motors of any conventional type, storage batteries being provided to help the generating unit at times of great power consumption, the power given out by the battery at such times being restored by the generating unit at times of light load.

Mr. Patton's first experiments in this direction were made some seven years ago, using gas engines with mechanical transmission to the wheels. The difficulties incident with varying loads and the necessity for reversing showed the necessity of substituting some



The Patton Motor Car.

more flexible transmission system, preferably with a means of storing the power between the engine and the wheels. Compressed air was considered, but electricity was finally adopted, with storage batteries to hold the reserve power. Some experiments were made in 1892, but little was done until about a year ago, when a car was equipped with an 18-hp gas engine, a 12-hp generator, a 35-hp motor and a battery of 92 150-ampere hour storage cells, the weight of this machine being about 11 tons.

During the construction of the overhead work on the Suburban Railroad in Chicago, a locomotive was at first used to move the tower car from place to place. The expense of fuel and labor on this locomotive amounted to about $13 per day, anthracite coal being used. Later, the Patton motor car, described above, was substituted for the locomotive, thus reducing the cost to $3 per day, only one man being required, and 15 gallons of gasoline being con-

*Abstracted from the *Railway and Engineering Review*.

sumed daily. The loads handled were surprisingly large. Five standard steam railroad cars, loaded with rails and ties, were repeatedly hauled around curves and at times up slight grades, the weight on the drivers being frequently increased by posting as many as fifty workmen aboard the motor car.

Encouraged by the success obtained with this machine, which was at best an improvised affair, a more carefully designed car has recently been built, and is now on exhibition on steam railroad tracks in Chicago. This car, which is shown in the accompanying illustration, consists of a closed car body, measuring 16 feet over all, mounted on outside journals in the ordinary manner. Between the wheels are special bearings supporting a steel frame, on which is mounted the engine and dynamo. These inside bearings are fitted with rubber cushions to give in a measure a spring support. The engine is a vertical Raymond two-cylinder, 25-hp gasoline engine, running at 300 revolutions per minute. The cranks are inclosed in a case partly filled with oil for lubricating purposes. An overhead tank of 25 gallons capacity contains the gasoline, two other tanks with a capacity of 75 gallons containing water for cylinder cooling purposes. This water circulates by gravity through a system of cooling pipes, which can be extended to trailers to serve for heating purposes in cold weather. Coupled to one end of the engine shaft is a six-pole 15-kw Crocker-Wheeler generator, the other end carrying an 850-pound fly-wheel. The generator is shunt wound, and designed for 220 volts. One hundred cells of 200 ampere hour storage battery are connected straight across the generator terminals. The truck is fitted with two 35-hp single-reduction motors, which are controlled with ordinary series parallel controllers. The storage battery is kept continually charged, except in cases of emergency, and is only used to smooth out heavy loads of short duration, rendering the load on the engine almost constant. As is well known this sort of work can be admirably done by a battery, which would soon get into trouble if depended upon for full charge and discharge. The simple shunt winding of the generator, and the governing of the gas engine, effects without further complication the proper distribution of load between the battery and the dynamo. The battery serves only as a very handy means of starting the engine from rest.

This particular motor car has already been sold to a street railway company in Cedar Falls, Ia., and another of equal capacity has been contracted for and is now nearly finished. The Patton Motor Company is now getting out plans for a car of 400-hp capacity to be used in suburban service, where high acceleration is desired. It is expected that a speed of 30 miles an hour can be obtained from rest, with a reasonably heavy train, in from twenty to twenty-five seconds time.

A Direct Reading Conductivity Bridge.

To the Editor of The Electrical World:

SIR—I notice in your issue of November 13 an article on "Conductivity Measurements with a Direct Reading Conductivity Bridge," by Elmer G. Willyoung and H. P. Harth.

I think that while the authors credited two parties for *valuable suggestions*, they might have looked a little further and said that the method was not their own, and that the apparatus was of another's design.

The adaptability of the Carey-Foster method to the method of the measurement of conductivity was first suggested by O. T. Louis, and the apparatus as first sold by Queen & Co. was the result of my own experimental work in their laboratories. The apparatus which they describe is entirely a design of my own (except the box on top for eliminating heating errors), even to the method of adjusting the resistance standards, as shown in Fig. 2. All of this is the result of experimental work with the original apparatus. Mr. Willyoung has had no experience with the original apparatus whatever, and Mr. Harth's was limited to some adjusting done according to my directions.

H. LYMAN SAYEN.

FRANKLIN INSTITUTE, PHILADELPHIA, PA.

To the Editor of The Electrical World:

SIR—With reference to the above letter by Mr. H. Lyman Sayen, touching the article by Mr. H. P. Harth and myself on "Conductivity Measurements with a Direct Reading Conductivity Bridge," appearing in your issue of November 13, and for advance perusal of which I am indebted to your courtesy, I may say that:

The original suggestion as to the adaptability of the Carey-Foster method to conductivity measurements was made neither by Mr. Louis nor by me, but very specifically by Professor Carey-Foster himself in his paper published in May, 1872.* Kempe, also, makes mention of this possibility, referring to the paper just cited (see "Handbook of Electrical Testing," Sec. 255). At this time Mr. Louis might, possibly, have been in knickerbockers; Mr. Sayen, I imagine, had not advanced so far in the evolutionary series. To me this same idea came quite independently in 1891 or 1892, the original Carey-Foster paper and the Kempe reference mentioned not coming to my notice till 1894 or 1895. The inference, certainly sufficiently obvious, may well have occurred to others also.

When I state that Mr. Sayen has, for a number of months, been in the employ of a firm engaged in the same line of work as is my company, and that his connection with the Franklin Institute, under cover of which he writes, is merely that of a member, as are hundreds of others, the true inspiration of his rather intemperate communication will doubtless be obvious, as will also my reason for not making any more detailed reply. I shall be glad, however, to furnish any interested parties with full information in the matter.

ELMER G. WILLYOUNG.

†Leeds Municipal Electric Tramway.

THOUGH some of the construction work in connection with the electric tramway at Leeds remains yet to be completed, a few electric cars for some weeks past have been running, and the work is now sufficiently far advanced to render an account of what has thus far been accomplished of interest.

Leeds was associated quite early with the electric traction movement in this country, for it was over a portion of the route taken by the newly equipped line that the historically interesting Roundhay line was laid—the first practical use of the trolley in England. While the work carried out when that earlier line was built the present equipment, however, has nothing to do, the recently-opened line having been constructed according to more modern practice and without making use of any of the original plant or materials.

Leeds tramways were formerly controlled by a limited liability company under powers obtained by Act of Parliament in 1871. The concession expired in 1894, in which year the corporation decided to avail itself of the famous purchase clause in the Tramways Act, and thereby to acquire the 22 miles of then existing lines belonging to the company, and to consolidate these with short lengths of tramway already built by the corporation. As required by law, the corporation sought to lease the tramway system to a new company, the lines being in the meantime worked by a staff under the direct control of the corporation; but, as has so frequently happened in other towns, it was found impossible to arrange such a lease, and the corporation was driven by the combined force of circumstances and popular feeling to seek from Parliament the necessary power to work the tramways permanently for itself. This power was granted in 1896. Prior to the passing of the act which conferred it, the advisability of running the lines by electric power instead of partly by horses and partly by steam locomotives, as was then the practice, was discussed, and it was decided to make practical trial of the trolley system on a working scale. The line selected for the experiment was that from Kirkstall to Roundhay, a line passing through the principal streets of the city of Leeds and offering considerable attractions to pleasure seekers at its two termini. It is this line that has recently been opened, and that we are now about to describe.

Permanent Way.—English practice has been exclusively followed in making the permanent way, unless we are to include in this the electrical bonding of the rail joints. The concrete bed varies from 6 inches to 12 inches in depth, being generally the former, and the composition of the concrete if four parts of 2-inch stones, two parts of sand and one part of Portland cement. Grooved girder rails are laid upon this bed weighing 100 pounds per yard and having a base

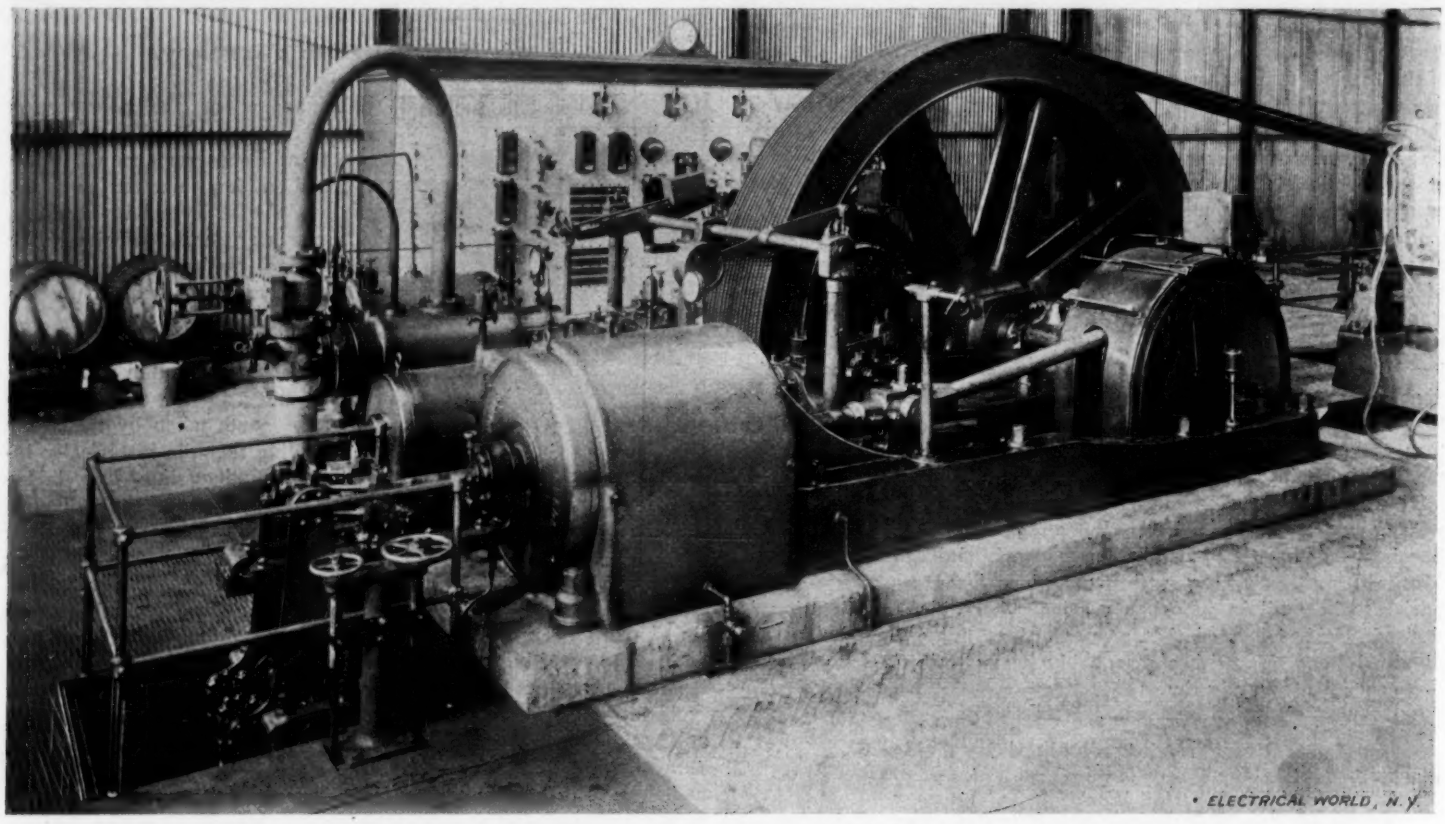
*See Jour. Soc. Teleg. Engineers, Vol. 1, Page 196.

†Abstract from the London *Electrician*, Nov. 11, 1897.

and depth each measuring 7 inches. The rail joints are made in the following manner: Beneath the flanges a 24-inch sole plate, weighing 40 pounds, is bolted with three bolts on each of the four half flanges, while on the sides of the webs are bolted a pair of fish-plates weighing 47 pounds. The bare copper bonds are carried beyond the rail joint, *i. e.*, they make connection with the rail webs at points outside the fish plates; they are in duplicate and are of the "Chicago" pattern. The rails of the double track are all cross bonded at intervals of 120 feet, *i. e.*, at every fourth rail. For keeping the rails to gauge tie bars are used at intervals of 10 feet, or three bars on every length of rail.

Overhead Trolley Equipment.—The overhead trolley construction of this tramway undoubtedly attains as high a degree of artistic merit as is possible with this class of engineering work, and we remember to have seen nowhere trolley poles and brackets and all the paraphernalia of the overhead system that so completely as those at Leeds have minimized the native unsightliness of their kind. Indeed, so excellent are they in design, and with such care has their position in every instance been selected, that throughout the entire run from the battery. The battery feeder consists of a single conductor of 0.17 square inch section; the three line feeders are concentric cables, each separate conductor having a section of 0.34 square inch. By the use of return conductors from all the feeding points the magnitude of earth currents and risk of electrolysis are diminished.

Rolling Stock.—When completed, the rolling stock will comprise some twenty-five motor cars, but the majority of these are not yet running. The cars, of one of which a general view is afforded, are double decked, and are mounted on Peckham rigid four-wheeled trucks. They have a wheel base of 6 feet and a spring base of 14 feet; they measure 26 feet from end to end, and have a seating capacity of fifty-one passengers per car. The wheels are 33 inches in diameter. Upon each motor truck are two General Electric-800 motors, with the usual series-parallel controller and reversing gear. The brake is controlled by hand, with the usual foot-ratchet detent; and, besides working the brake and the controller, the motorman has to attend with one foot to the single gong, and with the other to the sandbox. It is stated that on each



Cross-Compound Engine and Switchboard.

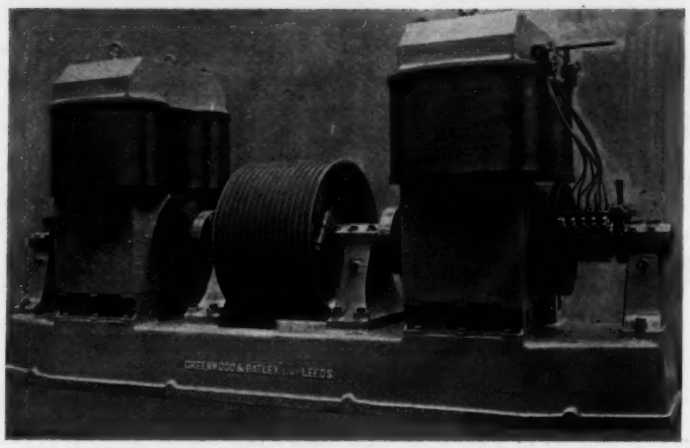
Kirkstall to Roundhay we saw nothing that might not grace an elegant boulevard. With what favorable opinions must the residents of the neighborhood contrast them with the ugly span lines and double lines of poles that formerly were to be seen along the same route. Both sides and centre poles are employed, with single and double brackets.

The poles are of hollow steel, in two sections, and measure 31 feet in height. In all there are 284 side poles, thirty-five centre poles and eight poles for pull-overs and anchoring. The greatest length of any single bracket is 18 feet, while the shortest bracket measures only 8 feet in length. The trolley wires are heavier than usual, being 0.4 inch diameter, the extra weight being adopted in order to save copper in the feeder cables and to increase the life of the trolley. The wire is soldered to suspending ears of aluminum bronze, each 15 inches in length, a special form of section-insulating ear being used, of course, at the requisite points. In this latter the insulating gap consists of vulcanized fibre. At the section termini the trolley wires are supported by strain wires, in each of which there is a strain insulator. In many places along the route, where other overhead wires cross the tramway, guard wires are used. These details, together with the trolley wire, were supplied by Messrs. Laing, Wharton & Down.

At present there are four cables for feeding the line and charging car there is a recording meter as well as an ammeter. For the trolley arm the latest pattern of Mr. Blackwell's swivel arm has been adopted, and is found to give excellent results. In this arm the spring that maintains and regulates the pressure against the trolley wire is placed in a small cast-iron box at the top of the standard.

Storage Battery Plant.—It is intended that there shall be two battery sub-stations, one feeding the line near the Roundhay end, the other feeding it at Kirkstall. The Chloride type of cell has been adopted for both batteries, which have been made by the Chloride Electrical Storage Syndicate, of Clifton Junction. At the Roundhay battery sub-station there are 256 cells of fifteen plates, while at the other sub-station there is an equal number of cells, each of which, however, is provided with only eleven plates.

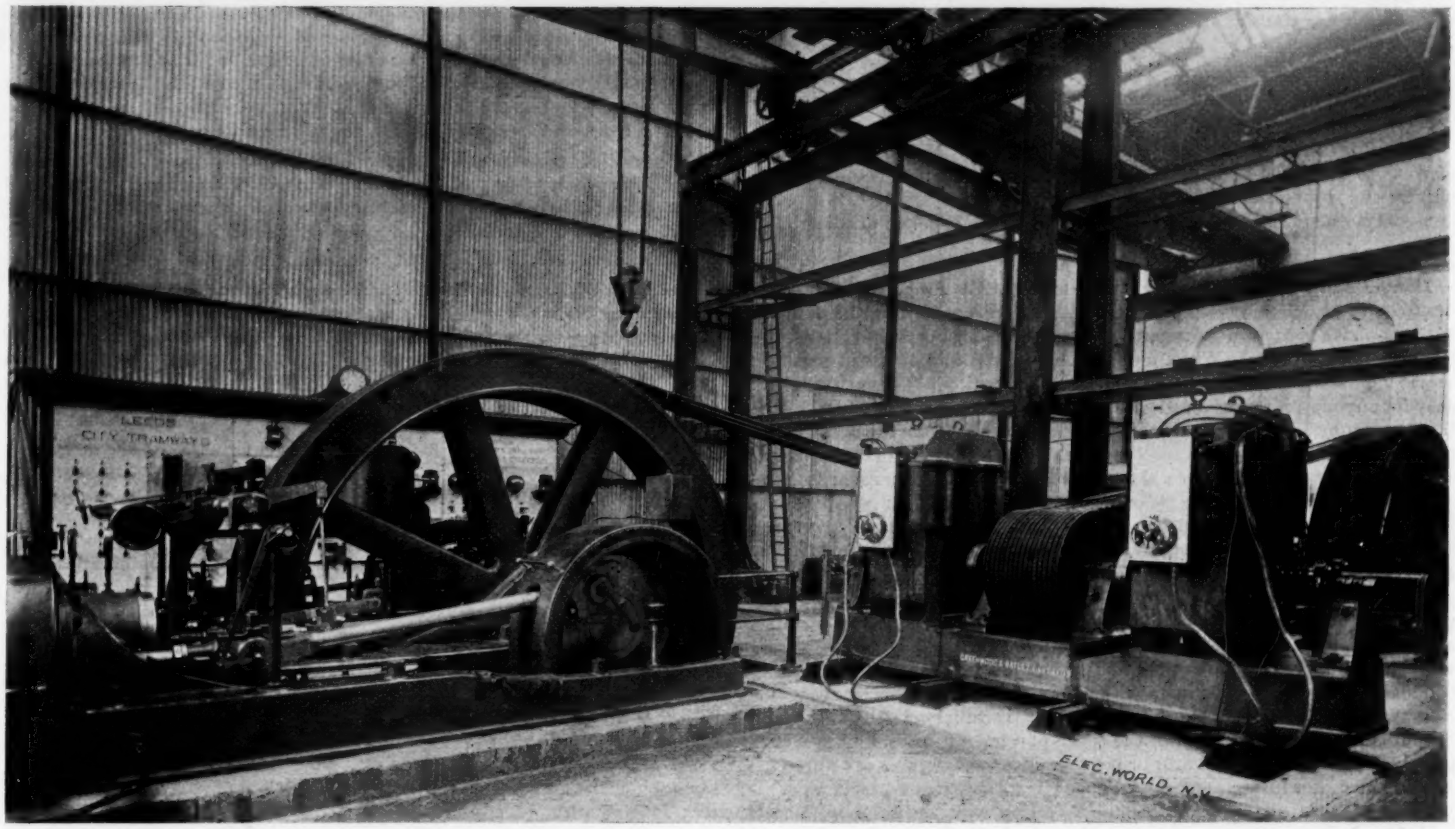
Power Station.—The power station is situated at some distance from the electrical section of the Leeds tramways, but on a site which is perhaps nearer to the centre than to any other part of that section. The machinery room measures at present 88 feet wide and 44 feet long—taking as the length the direction in which it can extend—and it is 47 feet in height. The boiler room is of equal height, and measures 71 feet by 47 feet; it is separated from the machinery room by a brick wall. In the angle formed by the abutment of the boiler house and machinery room an economizer house has been erected. The buildings are conveniently situated



TWIN GENERATORS.

Each dynamo set consists of two generators, which, electrically speaking, are separate in their action. Either or both may be connected direct to line or to battery, or one may be used for the one purpose, while the other performs the alternative operation. Each independent dynamo is a two-pole, drum-wound, over-compounded, continuous-current generator, capable of a normal pressure of from 500 to 550 volts, and an output of 200 amperes. A switch mounted on the field magnets enables the shunt coils to be cut out, or connected in series or in parallel, with or without resistance, in series with them. The normal speed of the dynamo shaft is 450 revolutions per minute.

In the boiler house there are now two Lancashire boilers and space for four additional boilers of the same type. These steam generators were supplied by Messrs. Clayton, Son & Co., of Leeds, and are each 30 feet in length and 8 feet internal diameter. They are constructed to work under a pressure of 120 pounds. Bennis mechanical stokers have been fitted to the furnaces, and the economy of steam generation is further enhanced by the addition of a

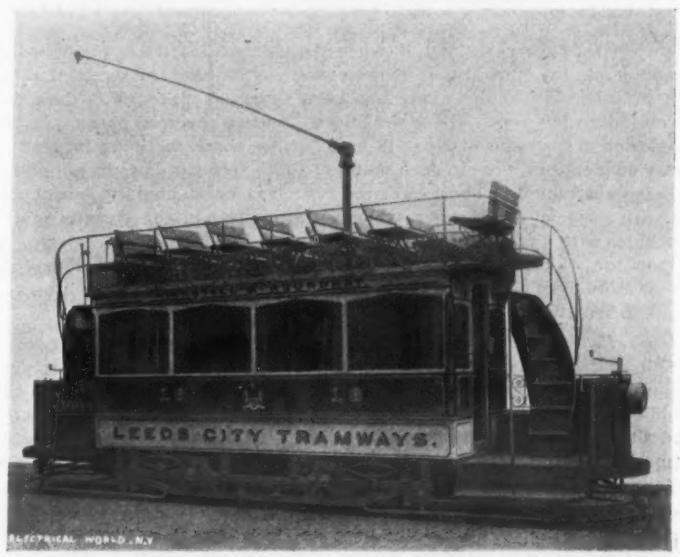


GENERAL VIEW OF ENGINE AND DYNAMOS.

for the supply of coal and water, being close to the Aire River. The two generating sets are of similar construction, each consisting of a horizontal compound condensing steam engine, built by Messrs. John Fowler & Co., of Leeds, and a twin dynamo plant, built by Messrs. Greenwood & Batley, who are the contractors for the whole of the plant and equipment. A general view of one of the steam engines is shown, as is also the twin dynamo, which consists of two separate dynamos built onto a single bed and with a pulley common to the two machines. We will now consider these items of plant in detail.

The engines are of the original cross compound type, a receiver being placed in the space between the high and low-pressure half engines, and the cranks being at right angles. Each engine runs at a speed of 98 revolutions per minute, the piston speed being 490 feet per minute; and when supplied with steam at 120 pounds pressure and working on the condensers it is capable of developing 400 indicated horse-power. The cylinders are 18½ inches and 32 inches in diameter, and are both jacketed. A 15-foot fly wheel on the crank shaft is grooved for fifteen ropes. It is scarcely necessary to state that the governor controls the expansion valve and not the throttle, but it is noteworthy that the governor is not of the crank shaft type, but is driven by spur wheels and chain gear. The engines are said to vary no more than 5 per cent. from the normal speed between zero and full load. As already indicated, the steam plant is provided with condensers, the pumps of which are actuated by the tail rods of the low pressure pistons.

Green's economizer in the flues. This economizer is built of 192 tubes, and the scrapers are worked by a small donkey engine, which also operates the mechanical stoker gear.



DOUBLE-DECKED ELECTRIC CAR.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES

COMPILED FROM FOREIGN AND AMERICAN JOURNALS

BY

CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Effect of the Form of the Voltage Curve on the Hysteresis Loss in Transformers. FLEISCHMANN. *L'Elec.*, Nov. 6.—A French translation, in abstract, of the article noticed in the *Digest*, June 19.

Alternator Design. FISCHER-HINNEN. Lond. *Elec. Eng.*, Nov. 5.—The beginning of a translation of the article which was abstracted in the *Digest*, Oct. 30.

Diphase Laboratory Plant for Instruction.—Lond. *Elec. Rev.*, Nov. 5.—A translation of a portion of the article noticed in the *Digest*, Oct. 30, including some of the more important illustrations.

Tests of a Continuous Current Motor.—Lond. *Elec.*, Nov. 5.—The results of some tests of a 20-kw Fynn four-pole motor, the results being given in curves; the Hopkinson method was used for the efficiency test, the result being 92 per cent. for each motor; the motors are well spoken of editorially.

Three-Phase Induction Motors. MORRISON. *Elec. Eng.*, Nov. 11.—The first part of an article giving practical suggestions concerning the running of three-phase induction motors, the proper transformer connections, the location of faults, etc. When a machine of this kind, whose operation seems very simple, fails to work properly, the location of the trouble is not easy for anyone not experienced with this class of motors. Should one of the three transformers break down the motor can be run from the other two if they are large enough; small motors should have a capacity in transformers slightly in excess of that of the motor; the figures are given regarding the ratios, but they are not quite clear; the full load current for small motors from 1 to 4 horse-power should be about 6 amperes per horse-power per leg at 110 volts; for any other voltage the calculation is easily made; for 4 to 50 horse-power the current is about 5.6 amperes, and from 75 horse-power upward it is about 5.2 amperes; the current, when running light, is usually 25 to 30 per cent. of full load; the current at maximum output is about 200 per cent. of full load; the "static" (starting?) current at full voltage with no resistance in the armature circuit is about 300 per cent. of full load; with all the resistance in the armature circuit the starting current and torque is about 150 per cent. of that at full load; the maximum output is usually 150 per cent. of the rated power, but this sometimes runs up to 200 per cent.; for elevator or hoist motors these figures are different; should the motor fail to come up to speed tests should be made for a reversed phase; a good test consists in feeling with the hand if there is any vibration other than the usual mechanical jarring, especially if there is also a humming sound; place the ear close to the frame while running and have the current thrown off and on a number of times; if the vibration noise ceases the instant the current is broken, a defective field may safely be assumed, and this may be due either to a short circuited turn or a reversed coil or phase; to distinguish between a reversed coil and a reversed phase it should be noticed that the unbalancing of the current and voltage will be greater with a reversed phase than if it is merely a coil and the motor will fail to carry its load; if, when the motor is started in the opposite direction and the current then thrown on it continues to rotate in that direction, it shows that the phase has been reversed although it does not always act in this way. He shows how to locate a reversed phase. In the conclusion in the issue of Nov. 18 he describes some methods for testing faulty connections, etc., in such motors; these descriptions do not admit of being abstracted; a short circuited turn may be located by burning it out with a special transformer, which is put in place of the armature. He concludes with a table of results of a test of a General Electric Company 5 hp-motor, which shows the effects on the current in the field of having one or more open circuits in the armature; the table will aid in testing out faults in armatures.

High Potential Transformer. TESLA system. *Elec. Eng.*, Nov. 11.—An illustrated description, taken apparently from a recent patent specification. The secondary coils are wound in the form of a spiral from the middle to the outside, the inner end forming one terminal and the outer end the other; the primary is around the outside only, and is connected with the outside terminal of the secondary, which terminal is also grounded; the convolutions of the secondary will therefore be further removed from the primary as the voltage in them increases, the point of highest potential being the most remote from the primary, and there is but little difference between any two convolutions. The length of the secondary is made approximately equal to "one-quarter of the wave length of the electrical disturbance in the circuit including the secondary coil, based on the velocity of propagation of electrical disturbance through such circuit, or, in general, of such length that the potential at the terminal of the secondary, which is the more remote from the primary, shall be at its maximum. If the rate at which a current traverses the circuit including the coils be 185,000 miles per second, then a frequency of 925 per second would maintain 925 stationary waves in a circuit 185,000 miles long, and each wave length would be 200 miles in length"; for such a frequency the secondary would be 50 miles long, so that at one terminal the potential would be zero and at the other the maximum. Instead of winding the coils as a flat spiral they may also be wound like a cone.

Care of Dynamos. DOMVILLE. *Can. Elec. News*, Nov.—A reprint of a recent paper on dynamo troubles and how to overcome them, giving hints on the care of a dynamo and describing the accidents which are likely to occur.

LIGHTS AND LIGHTING.

Incandescent Lamps. RICHARD. *L'Eclairage Elec.*, Oct. 30.—A well illustrated article taken apparently from patent specifications, and describing recent improvements in lamps and their method of manufacture.

Train Lighting on a French Railway. SARTIAUX. *Elek. Anz.*, Oct. 28.—An illustrated reprint in German of his descriptive article which was noticed in the *Digest*, Oct. 16.

Train Lighting.—West. Elec., Nov. 13.—A brief, illustrated description of a plant on a limited train of the Lake Shore Company, which has recently been put in service. There is a plant in the forward end of each baggage car consisting of an engine-dynamo driven by steam from the locomotive; the train is wired on the three-wire system; combination fixtures are used, as electricity is replaced by gas after 11:30 P. M. There are nearly 400 lamps on an eight car train; when the locomotive is disconnected the circuits are connected to a source of current at the station; it has been in operation for about a week.

Train Lighting in England.—Elec. Eng., Nov. 18.—A reprint of the article from the Lond. *Elec.*, describing the system used on the London and Northwestern, which was recently noticed in the *Digest*.

Electric Light Arches.—Elec. Eng., Nov. 11.—A brief, illustrated description of the arches across a city street in Columbus, Ohio, for decorative lighting with incandescent lights.

Electric Lighthouse.—El'ty, Nov. 17.—A reprint of a few notes on the Penmarch Point lighthouse, which was recently referred to in the *Digest*; it is said to be the most powerful electric lighthouse in the world, and will have a candle power of 36,000,000; it is called the Eckmuehl lighthouse.

POWER.

Ventilating Fans. WALKER. Lond. *Elec. Eng.*, Nov. 5.—A reprint of a recent paper read before the Institution of Mechanical Engineers, which is supplementary to his paper read in the spring; it is on ventilating fans in general without particular reference to electrically driven fans, but the data is of interest to those who make such fans. The discussion of this paper, which is quite long, is reprinted in London *Engineering*, Nov. 5.

Hercules Turbine. REYVAL. *L'Eclairage Elec.*, Oct. 30.—An illustrated article on this turbine for water power.

Parsons Turbines for the Blackpool Railway.—Lond. *Lightning*, Nov. 4.—A brief, illustrated description of the 100-kw tandem turbo-dynamos which have been installed for operating the Blackpool trolley line, and are running very satisfactorily; it was thought by many that they would not be suitable for traction work where slow-running engines with heavy wheels are almost invariably used; it is shown, however, that there is but little ground for this prejudice.

Progress of the Steam Turbine. PARSONS. Lond. *Elec. Rev.*, Nov. 5.—The beginning of a reprint of a recent paper read before the Institute of Marine Engineers.

Laval High-Pressure Turbines.—Elec. Eng., Nov. 11.—A brief, illustrated description, reprinted from *La Nature*, of the plant at the Stockholm Exhibition, which was referred to briefly in the *Digest*, Nov. 6 and 13; steam pressures as high as 220 atmospheres were used; diagrams of the engine, boiler, etc., are given.

Steam Turbine.—El'ty, Nov. 17.—A reprint of the article noticed in the *Digest*, Nov. 13.

Electric Drill.—Eng. and Min. Jour., Nov. 13.—An illustrated description of the Bladray drill, taken from a South African mining journal. It is a motor drill, the motor being axial with the drill shaft and operating a cam connected with a spring which imparts the percussive motion; there is no differential gearing, and there are only a few working parts; the motor is run by polyphase currents, the armature having no windings, and there are no commutators and brushes; it is claimed that there is a saving of about $50,000 in the first cost of an electric tunnelling plant (size not given) as compared with a compressed air plant of the same capacity, while the monthly cost of operation is only about one-third.

Motors in Factories.—Elec. Eng., Nov. 18.—An illustrated description of a large new plant, for both lighting and power, in the factory of the Linotype Company. This factory was formerly run by belts and countershafts, which have been replaced by motors which are directly connected to the ends of the shaft; a direct comparison can be made in this plant between the cost of operation by a belted and an electric motor plant; the old steam plant was entirely abandoned.

Shipbuilding Tools.—West. Elec., Nov. 13.—A reprint of the illustrated description recently noticed in the *Digest* of some of the electrically operated tools used in an Austrian shipbuilding plant.

TRACTION.

Traction Resistance of Carriages.—L'Eclairage Elec., Oct. 23.—Brief statements of the results of some tests, some of which are of American origin and the others were obtained by Fonvieille, chiefly for comparing iron, solid rubber and pneumatic tires; they appear to be those given by Hospitalier in his recent article; the traction in kilograms per ton is given for different kinds of roads and speeds; they show that the advantages of pneumatic tires over solid tires is never less than 10 per cent. and can be as much as 30 to 35 per cent. on poor roads. The French figures are reproduced in *El'ty* (N. Y.), Nov. 17.

Roller Bearings. HOW. Lond. *Elec. Eng.*, Nov. 5.—A note referring to his recent paper discussing the requirements and details of construction of roller bearings and giving results obtained. In the case of railway vehicles the starting effort was reduced to as little as 3 pounds per ton "of load"; there was found to be a large saving in the fuel consumed; careful experiments were made with the relative starting effort and running traction of street cars fitted with the ordinary and with roller bearings; for a weight of 4 tons 15 cwt. there was a saving in favor of roller bearings of 84 per cent.

Trolley Wire.—Lond. *Elec. Rev.*, Nov. 5.—Results of some recent tests of the tensile strength of English and American trolley wires; the average is about 23 tons per square inch, being slightly higher for the English than for the American, but both are very much less than the 30 tons required in many specifications.

Overhead Trolley Construction.—Lond. *Elec.*, Nov. 5.—A few illustrations of typical American construction, followed by one showing the artistic pole and bracket construction used at Budapest; the fiddle-bowl suspending system for the span wire is used.

Locomotive for Heavy Traffic.—Lond. *Elec.*, Nov. 5.—An illustrated description of the locomotives built by the General Electric Company, of Berlin, for the standard gauge and conditions for rolling stock of the German railways.

Switching Locomotive.—Elec. Eng., Nov. 18.—An illustrated description of a large switching locomotive designed by the General Electric Company, of Berlin, and adapted for the standard Prussian State Railways.

Heilmann Locomotive.—Elec. Eng., Nov. 18.—A note stating that according to a recent dispatch from Paris a trial had been made of the new Heilmann locomotive; the speed, however, did not exceed 18 miles an hour; the locomotive was 18 metres long and weighed 125 tons; it is regarded as a great improvement on the first one, and the directors of the railway company, it is said, have decided to adopt it.

Car Heating. DAMON. *Elec. Eng.*, Nov. 11.—A short article making calculations of the amount of heat necessary to heat a car, assuming the outside temperature to be 0° F.; he shows that it will take 5.03 kilowatts to heat a car for twenty-four people to 60° F., the window surface being 100 square feet, which corresponds closely to the present practice, which is about 6 horse-power. Comparing the amount of coal for this and for the direct heating, he finds that the efficiency of the electric heating is 11.37 per cent. and that it takes 5.27 times more fuel to heat the cars electrically than by stoves. In a few concluding paragraphs in the issue of Nov. 18 he shows the importance of using double windows, as the cooling surface would then be reduced to such an extent that only one-half of the coal need be burned; this for a system of 100 cars would mean a saving of 11,250 pounds of coal per day.

Electrolysis of Pipes.—West. Elec., Nov. 13.—The results of recent experiments by the chief electrician of Chicago; one of the large number of diagrams giving the results is reproduced; exceedingly dangerous currents were found in some places in the pipes; he recommends that a certain company be required to re-bond all their rails and to add the necessary copper return; he thinks that in the course of two years it will become necessary to make a great many repairs of the water pipes in that city.

Electrolysis of Pipes in Washington.—West. Elec., Nov. 13.—A brief abstract of the recent report by Inspector Allen, giving the results of investigations; he recommends the use of the double trolley system; Davis of the Naval Observatory in that city states that the magnetic observations in that observatory have now been rendered practically useless by disturbances caused by a neighboring electric railway; it will be necessary to remove the magnetic instrument to a distance of at least 2 miles before the local disturbances will cease to be felt.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Central Stations in Germany Considered from a Commercial Standpoint. LUX. *Zeit. f. Beleucht.*, Oct. 20 and 30.—A long article containing numerous tables of data; it is supplementary to his recent article on central stations in Germany; in the present article he considers them from the financial standpoint in order to show whether or not they are a success commercially; to be a success they should benefit the consumer and those who invest the money in them. The tables contain complete data for ten stations in Germany, including those in Berlin; reductions of the cost per kilowatt, the cost of operation, the income, profits, etc., are tabulated. The only general conclusion that appears to be drawn is that the average interest on the normal capital is 5.77 per cent., but as the actual subscribed capital is considerably less, the real interest on the investment is greater than the above amount.

Flat Rates.—Elec. Eng., Nov. 11.—A brief communication from a station manager, giving figures which tend to show how a station may be operated economically under the contract system at a time limit for burning. While he does not advocate the contract system, yet he believes that in some cases it is the best, as a customer is more easily obtained if he knows the exact cost each month before hand; his experience during ten years has shown that such a system may be very successful; the operating costs of a central station are given, the current for which is sold on the contract system.

WIRES, WIRING AND CONDUITS.

Earthing.—Lond. *Lightning*, Nov. 4.—A short communicated article in which it is urged that the general method of earthing at the supply station end of the mains does not embrace all the advantages to be gained by earthing; there still remains to prevent the traverse of leakage currents through long distances of earth from one leaky installation to another, which is known to be the cause of many troubles; this can be overcome by confining the leakage of each installation to itself, which could be effected by making an earth connection of one of the mains at each house; this is the system which he recommends.

Devices for Supporting Large Conductors. SHARPSTEEN. *Elec. Eng.*, Nov. 11.—The first part of an article in which he give practical instructions how to string heavy conductors in open work; he describes a plant for wiring the back of a switchboard in a railroad power house to the point where the wires leave the building, the wires being 1.5 inches in diameter. In the conclusion in the issue of Nov. 18, he describes a method for stringing very large wires in conduits or subways which were originally constructed for steam and water pipes.

ELECTRO-PHYSICS AND MAGNETISM.

Theory of the Induction Coil. WALTER. Lond. *Elec. Rev.*, Nov. 5.—The conclusion of the translation noticed in the *Digest*, Nov. 13 (in the abstract of the first portion the word "magnetic" in the third line from the bottom of page 594 should evidently read "maximum"). Beside the results already mentioned, he points out a curious consequence of his equation, namely, that the maximum spark length is independent of the coefficient of self-induction and the resistance of the primary and secondary; if this theory is applied strictly to all cases the E. M. F. of the secondary should be greater the smaller the capacity of the condenser; but there is a lower limit of the size of the condenser below which the formula does not apply. Another condition for the highest possible E. M. F. in the secondary is that its coefficient of self-induction should be as high as possible. One of his conclusions is that the length of sparks in air is proportional to the E. M. F. which produces them; he calculates that a 20 cm spark requires 130,000 volts; also that the E. M. F. introduced in the primary by the break of the circuit in a certain case would amount to 2750 volts if there were no leakage at the spark gap; he estimates by allowing for this leakage that it is only 1840.

Dielectrics. FERRY. (Univ. of Wisconsin.) *Phil. Mag.*, Nov.—An illustrated article on the specific inductive capacity of dielectrics in slowly and rapidly changing electric fields. The object of the investigation was the perfection of the zero method of determining this capacity of crystals and other substances that do not require large masses to be used, nor the dimensions to be known, nor to have the specimen of any particular shape; it is also a sensitive method, and the labor of computation is reduced to a minimum; the frequency of the oscillations can also be easily obtained experimentally. The method consists in getting two electrical systems of equal self-induction in resonance with a third system in which rapid oscillations are set up; diagrams and illustrations are given. The values obtained show that there is a difference in the constant for rapidly changing and slowly changing fields, and it is thought that this difference should be proportional to the electric absorption of the substance.

Hertz Waves and Metallic Enclosures. Lodge. *Phil. Mag.*, Nov.—A note calling attention to a published misstatement to the effect that electric waves of moderate length can penetrate a complete metallic enclosure and affect the coherer inside; in 1894 he showed that they can get in by insulated wires or by interruptions of the metallic conductivity, but into a cavity really bounded by conducting walls of fair thickness they do not go. He considers it absurd to speak of "Marconi waves," as though they were novelties unknown to science.

Coherers. Calzecchi. *Nuovo Cimento*, Sept.; noticed briefly in the Lond. *Elec.*, Nov. 5.—He claims priority over Branly, of having discovered and used coherers which he described in that journal in July, 1884; he used the coherers for various practical purposes, but not for wireless telegraphy.

Theories of Electricity and Magnetism. Boltzmann. Lond. *Elec.*, Nov. 5.—A communication in which he defends himself and Curry's book against the criticism of a reviewer of that book in that journal.

Resistance of Iron Oxides. Abt. *Beiblaetter*, 9, p. 744; noticed briefly in the Lond. *Elec.*, Nov. 5.—He made conductivity measurements of a large number of iron ores, mostly oxides and sulphides, and obtained results consistent in themselves, but he found it impossible to attribute any certain conductivity to each mineral.

Absorption of Röntgen Radiation. Humphreys. (Univ. of Va.) *Phil. Mag.*, Nov.—A short article describing researches made to determine whether the absorption of these rays depends on the kind of elements and amounts, or to some extent on the manner in which the elements are combined, that is, whether it depends at all on the grouping of the atoms in the molecule; he found that the absorption is chiefly, if not entirely, an atomic phenomena, and therefore the absorption due to a compound differs but little, if at all, from the sum of those of its constituents. In the experiments the rays were passed through compounds, and also through "equivalent thicknesses" of its constituent elements; from the small number of substances examined he believes that possibly the Röntgen ray absorption is an atomic one, and he concludes that, if so, all compounds none of whose elements were highly absorptive would transmit the rays, while all those containing one or more elements which in the free state were opaque would themselves be opaque; about forty compounds of a varied nature were examined; it also seems that the absorption is a function, though probably not a linear one, of the atomic weight.

Gases Exposed to Röntgen Rays. Rutherford. *Phil. Mag.*, Nov.—A long article on the velocity and rate of recombination of the ion of gases exposed to Röntgen rays; he investigated the duration of the "after-conductivity" of air and other gases exposed to these rays, and determined the velocity of the ions from this data. No general conclusions are drawn.

Magnetic Deflection of Cathode and X-Rays. Metz. *L'Eclairage Elec.*, Oct. 30.—A reprint of an Academy note describing experiments. The only difference in the results between this and his previous experiments is that the fluorescent spot was always diffused, even when the vacuum was very high. Several other Academy papers on Röntgen rays (already noticed in the *Digest*) are also abstracted in that issue.

Ferro-Magnetic Properties of Iron and Steel. Fleming. Lond. *Elec.*, Nov. 5.—A continuation of the reprint of his lecture (see *Digest*, Nov. 13). He continues the discussion of his interesting hypothesis. He shows that the magnetic moment of the molecule is proportional to the electric moment. The great difference between ferro-magnetism and para-magnetism or dia-magnetism seems to indicate that the first is a physical quality of a special kind and he therefore does not consider the application of the hypothesis to the two latter; the cause of ferro-magnetism is thought to lie in the unique structure of the molecule of iron or other ferro-magnetic body, whereby it has a finite electric moment below a certain temperature and that the rise of temperature ultimately brings about a rupture of the molecule by increasing the angular velocity of rotation beyond the point at which the inter-atomic electric forces can hold the original structure together. He then discusses whether there is any evidence of changes in the iron at the critical temperature which would indicate something like a molecular decomposition; a curve is given for the variation of the specific heat of iron with temperature and which shows a maximum point at about 850° C., which is a little above the critical temperature; this suggests some internal work analogous to dissociation; a remarkable change also takes place in the electrical resistivity of iron at the critical temperature; this he shows in a diagram; he then summarizes the physical properties of iron at 1000° and at 100° C., showing that the iron is really an entirely different substance at these temperatures; this points to a breaking up of the molecule or some equivalent change.

Specular Iron Ore. Westmann. *Beiblaetter*, 9; noticed briefly in the Lond. *Elec.*, Nov. 5.—He measured the magnetic properties; it was found the pieces were magnetized in a strong magnetic field, but that the magnetic axis often made a small angle with the direction of the original field; the magnetic permeability was 0.2 per cent. of that of wrought iron, and it showed high coercive force; it was para-magnetic in every direction.

Photographs without Light. Russell. *Elec. Eng.*, Nov. 18.—An abstract of a Royal Society paper. He repeated Becquerel's well-known experiments and found that the peculiar action which the latter noticed with uranium salts was not confined to that material, as there are many other bodies, such as wood, charcoal, copal, straw, etc., which possess it in a marked degree; the radiations from these, however, differ from those obtained from uranium compounds in that while the latter readily pass through glass, the former are completely stopped by it. The radiations were also obtained from cardboard and from some kinds of printers' inks, while other kinds produced no action at all. He claims to have established that an increase of the temperature of a body greatly increases its activity, and that aqueous vapor in no way assists the action.

Effect of X-Rays on the Animal Organism.—Elec. Rev., Nov. 17.—A brief extract from the Lond. *Lancet* of a communication made by Courmelle to a recent Congress. He states that if a vacuum tube is wrapped in black cloth, which stops the visible or light producing rays, injury to the skin is unusual, and even after a prolonged exposure is not serious; it appears that it is only the cathode rays which are injurious, and there is no difficulty in excluding these.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolytic Production of Lead Compounds.—Elek. Anz., Oct. 31.—A brief description of the Lukow system of manufacturing white lead, peroxide of lead, lead chromate, etc., by a purely electrolytic process, with which it is claimed that the present chemical processes do not compare in the quality and purity of the product and the cost of production. The electrolytes are extremely dilute, containing only 1.5 to 2 per cent. of the salt in solution; the electrolyte always consists of two different salts in solution, one of which is to dissolve the metal of the anode, while the other changes the dissolved metal into the desired compound; the relative amounts of these two salts depend on the product to be produced; the anode is always that metal whose insoluble compound or oxide is to be produced; for the sake of purity the positive and negative electrodes are made of the same material, the cathode being surrounded by a bag to catch the impurities; the current density should be rather low and is different for the different products. A table is given showing the current density, voltage and composition of the solution for various lead and copper compounds. These processes have been tested in practice in Cologne, where a large factory is at present under construction for making white lead.

Electrolytic Alkali. Kershaw. Lond. *Elec.*, Nov. 5.—A short article discussing the present position and future prospects of the three processes. The Castner-Kellner installation for producing caustic and bleach is working satisfactorily, and the 1000-hp plant, which was started in March, is to be doubled in January, and is soon to be increased to 4000 horse-power; its whole product has been sold for three years; from the capital invested and the output, it is found that the actual cost of manufacture, not including interest and depreciation, must not exceed $66 per ton of 70 per cent. caustic soda and 2.1 tons of 35 per cent. bleaching powder, in order to yield a profit, after allowing for interest and depreciation. The Niagara Company is expected to pay a dividend at the end of the first year. The installation using the Richardson and Holland process, at St. Helens, is still in operation, reports to the contrary notwithstanding; the Hargreaves-Bird process is still being worked on an experimental scale at Widnes. In Germany the exports now greatly exceed the imports of these materials, the change being due to the electrolytic methods which have been in use since 1892.

Chlorine from Chloride of Calcium.—L'Eclairage Elec., Oct. 23.—In the Solvay process for making carbonate of soda the residue is chloride of calcium; Kellner has devised the process, which is briefly described, for obtaining the chlorine from this product; one of the electrodes is of carbon, placed between diaphragms which are not attacked by chlorine; the others are discs of iron, turning around a horizontal axis and provided with scrapers to take off the hydrated chalk which forms on their surface; no further description is given.

Bleaching Sugar.—L'Eclairage Elec., Oct. 23.—A brief description of the Urbain process. The juices are acted on simultaneously by the sulphurous acid and electrolysis; at the cathode there is produced hydrosulphurous acid, which is an energetic bleaching agent; the impurities in the sugar form insoluble metal salts with the metal of the soluble anode; it appears that the anodes are lead, and alternate with cathodes of zinc, and they are close together to reduce the resistance; no loss of sugar by inversion takes place; for the same quantity of sulphur the bleaching is much greater than with the anhydrous sulphide alone; for the raw liquor he prefers anodes of zinc instead of lead; the results obtained in an experiment are given in a table and are favorable to the method.

Theory of Ionic Dissociation.—Lond. *Elec. Rev.*, Nov. 5.—An abstract of an article showing the importance of this theory of Arrhenius in analytical chemistry; the reference to the original article is not given.

Electro-Chemistry in Russia. Roestin. *L'Eclairage Elec.*, Oct. 30.—A long abstract of the article which was noticed in the *Digest*, Sept. 25.

Accumulator. Digoine. *Cosmos*, Oct. 23.—A brief, illustrated description of his plate, which consists essentially of two perforated castings containing between them a compressed mass of lead wires, the latter being the active material, while the castings form a sort of conducting frame for them.

Electrolyzer. Rhodin system. *Elec. Rev.*, Nov. 17, and *Elec. Eng.*, Nov.

18.—A reprint, with illustration, of the description of the apparatus noticed in the *Digest*, Nov. 13.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Meters. BROWN and ROUTIN. *L'Eclairage Elec.*, Oct. 23.—A long article which is a general discussion of the subject of meters and contains the results of very extended researches with several meters, the names of which, however, are not given. The systems of charging for electric energy are discussed; among the nine methods enumerated they conclude that the only rational one is a variable tarift based on the curve of consumption, a system which is used in Norwich and Bristol, England; a consumer who uses the current for light really receives light, as distinguished from watt hours of energy, and if therefore he pays for the latter it is not rational, as the number of watt hours per candle is a function of the voltage, and the specific consumption depends on the age of the lamp; for a single lamp or group of lamps lit simultaneously a simple hour meter is sufficient; for independent lamps it is a matter of indifference whether a watt-hour meter or ampere-hour meter is used; for motors a simple hour meter is sufficient in most cases. They discuss the different methods of charging; the price should vary periodically; the price per unit is very nearly inversely proportional to the number of units furnished; the rate of the demand is variable, depending on the hour of the day or night when the current is used; a rational system should therefore contain two prices, the high one for the hours when light is most in demand, and the other, the lower, for the rest of the period of twenty-four hours; the hours governing these periods vary with the seasons; to offer a reduction for the total number of units is an incorrect application of the principle of reduction for wholesales; the Wright and the Andrews methods are theoretically the closest approaches to the ideal; they are, however, based on the curves of consumption instead of on the "curve of the total charge," thus introducing an important error, as the maximum demand does not always occur at the same moment; moreover, such a method is not easily explained to the consumer; the Rapp method is also discussed, and they state that they intend to describe in detail the way in which they have overcome all the difficulties and complications in this, by a method which is based on a variable tariff; (this method, however, does not appear to be described in the present article). They then give at some length the results of an experimental study for the principal meters in use, indicating them by arbitrary letters, and not by name; they describe a graphical method devised by them for obtaining the value of a certain integral; the diagram is based on polar co-ordinates. In their conclusions they state that the correctness of the motor meters is much less than is generally supposed; the theoretical proportionality does not exist in any of the types tested, and the errors are too great to be allowed in practice, even on circuits without self-induction, while in those with self-induction they may be very high; the energy consumed in the shunt circuits of the meters is generally quite high, and averages as much as for a 10-cp lamp running two hours a day; the starting current in two of the meters was such that a single 16-cp lamp current may not be registered; moreover, there is a variation in the constant of the meter due to the variable resistances and changes in the permanent magnets.

Magnetic Units. BLONDEL and BRYLINSKI. *L'Eclairage Elec.*, Oct. 30.—Two communications; in the first one Blondel, in referring to the recent paper of Brylinski (see *Digest*, Oct. 16), gives a further explanation of his ideas, which the latter criticised owing to a misunderstanding. In order to distinguish between the quantities usually represented by B and H and which he claims create confusion in the present system, he suggests calling the induction the quotient of a flux of induction by a surface; B would then be equal to H multiplied by the factor K and would be measured as an induction in webers per sq. cm.; H he calls the field in a substance and K the magnetic inductive power; the permeability is then the quotient of B over H and therefore equal to K; this would make the permeability equal to the magnetic inductive power, which is not according to Maxwell and Thomson; he sees no reason, however, why modifications in the present system should not be made; the advantages are discussed, among which are the fact that the conventional method of making K equal to 1 disappears, and this was the weak point in the electro-magnetic system; the permeability is then a quantity having a specific unit to which he proposes to give the name of oersted; the oersted would then be the permeability of a vacuum or air; moreover, these definitions would be much more easily understood by students. He sees no reason why a name should be given to the fall of magnetic potential per unit of length any more than to the fall of electric potential; it should be represented in kelvins per centimeter instead of per quadrant, which then makes a maxim equal to a kelvin over a weber; with this modification and using the weber per sq. cm. as the unit of induction, Brylinski's system does not differ much from that which Blondel proposed at the Carthage Congress in 1896. In the reply by Brylinski he admits that the proposed definitions have their advantages, though they are not fully satisfactory; he suggests that they should be considered; he recommends the adoption of a unit for permeability, but it should not change our present systems materially.

Differential Telephone Method of Measuring Resistance. FREDERICO. *Nuovo Cimento*, Sept.; abstracted with an illustration in the Lond. *Elec.*, Nov. 5.—The Kohlrausch method is subject to inconveniences arising from the lack of definition of the minimum point; the present differential method obviates this, and is claimed to be more exact and applicable to a wider range. A telephone disc is mounted between two electromagnets, the axes of which are in line; when the same current transverses both coils the disc is silent; a wire interrupter for generating the interrupted current is preferred, as it can be tuned to the natural period of the disc; the accuracy in measuring resistances of 10,000 ohms is 0.1 per cent., and the measurements require only a few seconds.

Measuring the Electrostatic Capacity of Long Cables. MURPHY. Lond. *Elec.*, Nov. 5.—A discussion of the unsatisfactory features in the Gott and other methods, followed by a description of a method devised by him, which he prefers and with which he usuall obtains better and lower results.

Permanency of Resistance Coils. AYRTON. Lond. *Elec.*, *Elec. Rev.* and *Elec. Eng.*, Nov. 5.—A short article giving the values of several standard coils tested some years ago by Jones, and again this year by Ayrton and Jones; from these there are reasons for concluding that the coils were in some abnormal condition when tested in 1896; from the results given it appears that these coils can be relied upon only to an accuracy of about 0 01 per cent.

Induction Coils.—L'Eclairage Elec., Oct. 30.—A brief, illustrated description of some recent improvements in the Apps coil. The mechanical strains on the insulator separating the primary and secondary and the secondary coils from each other are submitted to mechanical strains which reduce their resistance; a damaged secondary coil, moreover, cannot be easily removed; these difficulties are claimed to be overcome by these improvements.

Apparatus for Producing Tesla Currents.—L'Eclairage Elec., Oct. 30.—An illustrated description of the compact, simple and transportable apparatus made by Miller.

Amalgam Arc Lamp. GUMLICH. *L'Eclairage Elec.*, Oct. 23.—An illustrated abstract of the article noticed in the *Digest*, Oct. 16.

Range Finder. STROUD. *Elec. Eng.*, Nov. 5.—An abstract of a recent Physical Society paper describing the Barr and Stroud range finder.

Meters for Electro-Therapeutic Work.—Elec. Eng., Nov. 11.—A reprint of a brief report read before the American Electro-Therapeutic Association. It refers to ampere and volt meters for this kind of work, a number of which have been tested by the committee making the report; the Weston instrument is used as a standard; a number of those submitted for test have been withdrawn permanently owing to their inefficiency. They consider it undesirable to make a direct current instrument for reading higher than 100 milliamperes; the table showing the result of the test is not reproduced; it seems that ampere and volt meters for alternating currents, both interrupted and sinusoidal, have now been perfected; they are based on the electrometer principle, and the readings are the virtual or effective values, the deflection being independent of the frequency and wave form.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Printing Telegraph.—Lond. *Elec.*, Nov. 5.—A well-illustrated description of the Hoffmann system called the telescriptor; the main claims are for simplicity and compactness, the question of speed being of lesser importance; it is especially suited for replacing the old Wheatstone ladder instrument and for taking the place of the telephone on private lines where records are to be kept. The same instrument is used for sending and receiving; it is of the usual step by step kind, the two type wheels being brought into synchronism and the impression being taken by a printing magnet at the moment when the wheel stops; if an earth return is used only one line is necessary; type wheels are worked by clockwork and the line current is unidirectional; the instruments are connected in series; the maximum time to print a letter is slightly less than one second, and the average about one-half a second; the capacity of the line does not interfere with the working. A brief, illustrated description, but not including the diagram of the circuits, is published in the *Elec. Eng.* (N. Y.), Nov. 18.

Marconi's Telegraph System. ASCOLI. *Elek. Anz.*, Oct. 24.—A German translation of his article in *L'Elettricista*, 6-8. A theoretical discussion of some of the elements involved in the transmission of electromagnetic waves, with special reference to the vertical wires which are claimed to characterize that system, and by means of which the distance may be very greatly increased.

Telegraphic Annunciator. MONTPELLIER. *L'Elec.*, Nov. 6.—An illustrated description of the improved Mandroux system of operating annunciators to indicate the end of a message at stations where the circuit is to be disconnected.

Efficiency of Translators. REDING. *Jour. Télégraphique*, Oct. 25.—The conclusion of his article (see *Digest*, Oct. 23).—The results of his elaborate tests are given in tables and curves; no general conclusions are drawn.

Telephone Relay.—Elec. Eng., Nov. 11.—An illustrated description of the Erdman relay, in which the amplification of the sound is produced by air pressure. The receiving telephone is directly connected with a balanced valve through which the escape of the compressed air takes place; its mechanical vibrations are thereby imparted to another diaphragm through the intermediary of the pressure vibrations of the air current; this diaphragm acts directly on a microphone, thus transforming the mechan

ical vibrations again into electrical vibrations. Nothing is said of any trials or tests.

Telephone Load Lines in Chicago.—Elec. Rev., Nov. 17.—Reproductions of a few load lines for a certain day in each of four years, showing the growth; there is a first maximum about 10 o'clock, then a rapid falling at noon and a rising again in the afternoon, falling abruptly at the close of business hours after five o'clock. Fifty per cent. more business is now being carried on by telephone in that city than three years ago; it is said that the service in Chicago is far in advance of that in any city in the world.

Military Telegraph and Telephone Lines. Greely. *Elec. Rev.*, Nov. 17.—An abstract of a recent War Department report in which he mentions favorably the combined telegraph and telephone apparatus devised by Allen, and which he claims is distinctly superior to any previously constructed; it is mentioned in a general way, but not described.

Government Telegraphs in England.—Elec. Eng., Nov. 18.—A reprint of some of the statistics noticed in the *Digest*, Nov. 13.

MISCELLANEOUS.

Utilization of Ozone.—Lond. *Elec. Rev.*, Nov. 5.—An editorial article calling attention to some of the applications of ozone made by a certain company using the Yarnold apparatus, which, however, is not described, the patent being referred to for a description. The production is based on the so-called silent discharge, and it is claimed that a high efficiency is obtained (but no data is given); a 100-volt alternating current is stepped up to 12,000; the capacity of the plant is 1800 to 2000 cubic feet of ozonized air per hour (the percentage of ozone, however is not stated); continuous runs of several days and nights were made; the cost is less than 1 cent per 1000 cubic feet of "ozonized air," based on 8 cents per unit for the current; the entire cost of the plant, including steam power to produce 10,000 cubic feet per hour would not exceed $6,500. The various uses of ozone are mentioned; great success is claimed with its application in cleansing brewers' foul casks; also with the drying and cleaning of linseed oil at a cost of about $1 per ton of oil against $2.5 with the ordinary method, besides avoiding the danger of fire; peroxide of hydrogen can be very cheaply produced by ozone; according to a report by Riddal experiments have shown that ozone might prove very useful in the preliminary treatment of refractory gold ores; a report by Hurst of the application to oils shows that the samples treated are superior to many that are now being sold.

Lightning and Atmospheric Pressure.—Cosmos, Oct. 30.—A note on recent observations of Rosenbach, of Berlin, with an instrument which enabled him to measure small and rapid variations of the air pressure; he endeavored to find the connection between this pressure and lightning; preceding a strong lightning discharge there are considerable variations in the pressure, and immediately afterward or at the moment of the discharge there is a diminution of the pressure; this negative pressure could not have been the result of the lightning discharge; the greatest discharges were produced by continual and short variations. Analogous effects were produced with discharges from an influence machine. It may be admitted that the great variations in the electrical potential of the air are the cause of the variations of the air pressure and the lightning.

Stockholm Exhibition.—Lond. *Lightning*, Nov. 4.—A brief account of a visit to this exposition.

Electric Laboratory Stove.—Eng. and Min. Jour., Nov. 13.—A brief, illustrated description from the *Journal of the American Chemical Society;* the stove is for use in chemical laboratories to replace the water bath; it has the advantages of being clean and dry and requires no attention; it supplies constant and dry heat; it is especially recommended where the danger from fire is to be avoided.

Electric Mail Box.—Elec. Eng., Nov. 11.—A note giving a brief account of a system of mail delivery boxes used in a number of large buildings in Geneva, Switzerland. The letters are delivered to the mail box on the ground floor, and this starts a bell ringing on the respective floor, which does not cease until the letter is taken out; the box is lifted on a small elevator operated by hydraulic pressure; it operates automatically.

American Electrical Engineering in Europe. Porter. *Elec. Rev.*, Nov. 17.—A reprint of an article from the Philadelphia *Inquirer*, showing how rapidly American electrical engineering is pushing its way in England and on the Continent; among the important directions he mentions mining appliances, those for the transmission of power, and apparatus for telephoning and for the electric light. Some statistics of exports of electrical apparatus from this country are quoted, and some others, showing the investments in electrical industries in England, are also given, together with some remarks on electric railways.

European and American Practice. McGhie. *Jour. of El'ty*, Oct.—An article comparing the practice of the two countries in electrical engineering.

Electrical Industries in Boston Thirty Years Ago. Edison. *Elec. Eng.*, Nov. 18.—A reprint of an article printed in 1868 for a newspaper at a time when he was a telegraph operator; it gives an idea of the manufacturers of electrical apparatus in Boston at that time.

Biographical. P. B. Delany. *Elec. Eng.*, Nov. 11.—A brief biographical notice, with portrait.

The Production of Incandescent Lamps.

The incandescent lamp, simple in appearance, is yet very complex in all its features. Probably in no other branch of the electrical industry does experience count for so much, nor any product in which the best results are absolutely dependent upon constant, careful continued inspection and testing. To secure a perfect product at the present low prices of lamps both extensive experience and heavy production are necessary. The General Electric Company during the hard times did not relax its efforts toward improvement in machinery, processes, inspection and testing, and the result to-day is that this company, with an output of over 6,500,000 lamps yearly, is manufacturing a better and more uniform lamp than formerly could have been procured for double the price. The lamp works is provided with a very complete laboratory, with a staff of competent chemists and electricians, constantly occupied in carrying on experiments and tests, all tending to the betterment of the product.

Perhaps the most noteworthy improvement introduced during the past two years is the new exhaustion process. By the adoption of this process the quality of the Edison lamp is said to be distinctly advanced beyond lamps exhausted by other methods. During recent years mechanical exhaust pumps —that is, pumps operated without mercury—have, from time to time, been presented, but in each case the size of the pump has been too great, the object having been to exhaust a large number of lamps at one time. This practice being considered injudicious such pumps have not been adopted, but the lamp works have succeeded in obtaining a small mechanical pump, with a rate of exhaustion such that it can practically be employed to exhaust one lamp at a time. Experiments with this pump lasted nearly two years, and showed that the lamps could be exhausted more nearly to the ideal lamp vacuum by this pump than by an other. It is now used to exhaust the Edison lamp, and the mercury pumps have been discarded. The final perfection of the vacuum, however, is not obtained by the pumps unaided.

In combination with these pumps a chemical process is introduced. It is said to be exclusively used in this country by the Edison lamp works, and as the various phenomena of exhaustion are clearly marked, a very definite rule of operation has been formulated.

The natural residual gases of an incandescent lamp may be considered conducting gases, since they allow current to pass from one leg of the filament to the other. The residual gases are, therefore, not only injurious to the filament, but their necessary removal has previously involved long and tedious processes. By the new method of chemical exhaustion all the residual gases are thoroughly removed from the lamp by the introduction of a gas capable of combining with them. Previous to this introduction a blue glow fils the bulb when the filament is brought up to bright incandescence, but when the combination takes place between the residual gases and the new gas, the blue glow suddenly disappears, and a lamp, "sealed off" at this moment has a vacuum of perfect insulating properties.

The advantages of the chemical process of exhaustion are several. The combination of the gases in the bulb is a phenomenon so marked as to furnish an absolute proof that the proper vacuum has been obtained. The lamps are exhausted one at a time, and the whole attention of the operator is concentrated on a single lamp. This insures a perfection of vacuum difficult to obtain in lamps exhausted in groups. The operator sits in a comfortable position, and, not unduly wearied, can do as accurate work late in the day as in the morning.

The injurious effects of mercury upon the health of the operator being avoided, his uninterrupted service is secured and the very highest skill dependent upon continued practice is retained.

Fire Extinguisher for Electric Stations.

The necessity for a means of extinguishing fires caused by the accidental short circuiting of heavy electric currents has long been recognized.

Switchboards in central stations, isolated plants and power houses are constantly exposed to this danger, and the same may be said of any installation where there is a multiplicity of wires and cables.

To attempt to cope with a fire in such a situation with the simple aid of water is more than useless, because water becomes an excellent medium for establishing other short circuits that probably would not occur at all if it had not been used. The use of water, therefore, in such an emergency becomes as much an element of danger as the fire itself.

The effect of carbonic acid gas upon fire is well known. In its presence no combustion can take place, and it kills a fire at once by depriving the fire of oxygen. A device is soon to be placed upon the market by the Underwriters' Fire Equipment Company, of Brooklyn, which seems to fill the great need for a fire extinguisher that will be efficacious in such situations as those above referred to. It resembles, in appearance, the familiar portable chemical fire extinguisher. In fact, it is a chemical extinguisher itself, with an additional chamber, which acts as a reservoir for the carbonic acid gas generated by the combination of a saturated solution of bi-carbonate of soda with sulphuric acid. The gas is forced out through a suitable nozzle by its own pressure and directly applied to the flames, which are immediately extinguished.

The design and construction of the gas extinguisher is remarkably simple, and its operation and control are equally simple. By an ingenious method of mixing the two fluids all danger from explosion is avoided.

The apparatus has been practically tested, and found to work with satisfactory results. The gas, as it is ejected from the nozzle, is perfectly dry, and has no damaging effect on the material to which it may be applied.

The above-named company has just been incorporated for the purpose of manufacturing and selling this "dry-gas extinguisher." The company has a capital stock of $150,000, and the directors for the first year are: Messrs. Robert Brown and Frank C. Mason, of Brooklyn; Messrs. A. C. Rowe, Frederick Pearce, Frank McGurk, Charles McGuire and Denis McCarthy, of

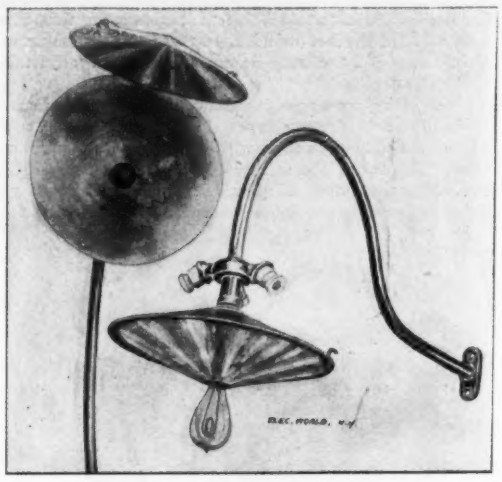
New York. The company's office is at No. 2 Wall Street, New York City, where a practical demonstration of the utility of the device will be made at any time for the benefit of those interested.

Improved Fixture for Incandescent Street Lamps.

An improvement in fixtures for supporting incandescent lamps for street lighting has been made, and is now being placed upon the market by Mr. G. H. Almon, Montpelier, Vt.

One of the chief results of the improvement is that the hood cannot work loose by the action of the wind, thus insuring a water-tight support for the lamps. The hood is held between two steel washers.

The illustration shows the improved fixture. The 4-foot goose-neck is made



IMPROVED STREET LAMP FIXTURE.

of ¾-inch pipe, the hood having a diameter of 16 inches and the deflector 14½ inches. The fixture is well painted, and fitted for ⅛-inch, or ⅜-inch socket, as desired.

The porcelain knobs are secured to the outside of the bonnet. This improvement avoids the cause of leakage, especially in stormy weather, which is an unavoidable consequence in the use of hoods of ordinary designs. In the improved form, the line wires clear the bonnet with ample and safe space.

Automatic Time Switch.

A device for automatically turning off and on the lights in a store has recently been perfected, and is being handled in the United States by the Western Electric Company, of Chicago and New York. This switch is a double-pole, 30-ampere, snap switch, with a capacity up to 220 volts, arranged in combination with a clock. Any person desiring his lights to burn until, say, 12 o'clock, or any other specified hour, sets the clock as he would an alarm clock, and turns on the lights. As soon as the time indicated by the little pointer on the dial of the clock is reached the clock automatically releases a catch, and the lights are turned out. The same device is used for turning on lights.

Where central stations are selling light by contract to burn to specified hours, these automatic time switches can be installed by the electric light company, the keys being carried by the inspector. By this means the company can be assured of having the light turned off at the time specified in its contracts with customers. If the customer has a meter and desires to keep his store illuminated until a certain hour he can, with perfect assurance, lock his door and leave the automatic switch to take care of the lights, knowing that his lights will not be taking current and a bill run up on account of lack of attention.

Portable Milliammeters for Alternating Current Circuits.

Over a year ago the Keystone Electrical Instrument Company, of Philadelphia, Pa., received a request from the Committee on Meters of the American Electro-Therapeutic Association, to design and submit for test a portable milliammeter for use on sinusoidal alternating and faradic current circuits. After several months careful experimenting the company succeeded in perfecting an instrument of this class, which practical test, it is stated, proved to be eminently satisfactory, and the report of the Committee on Meters presented at the last annual convention of the American Electro-Therapeutic Association contained an unqualified approval of the instrument.

In the course of the experimental work a number of tests were made with the milliammeter, and some data obtained on commercial apparatus which heretofore had only been obtainable by calculations. Among other things tested was the current consumption in the primary coils of transformers, when the secondary was in open circuit, thus determining directly and without calculation the idle losses in the transformer system. The result of the test showed a great difference in what might be termed the idle efficiency of transformers of various makes, and further showed a marked difference between new transformers and transformers in which the iron had aged as the result of long continuous use. The whole question is one of more than passing interest to central station managers, who generate alternating current, and careful tests of the amount of current required to energize the primary coils of transformers when the secondary is in open circuit, would no doubt lead to a more careful selection of transformers and the replacing of many which have outlived their usefulness. Direct reading in such matters is superior to calculation, and there is no doubt that many stations would discover unexpected losses by making a series of tests on the transformers now in use on their lines.

The milliammeter is neatly designed and mounted in a polished mahogany case. It is carefully calibrated, and its indications, it is stated, may be relied upon as being perfectly correct.

Electric Railways Abroad.

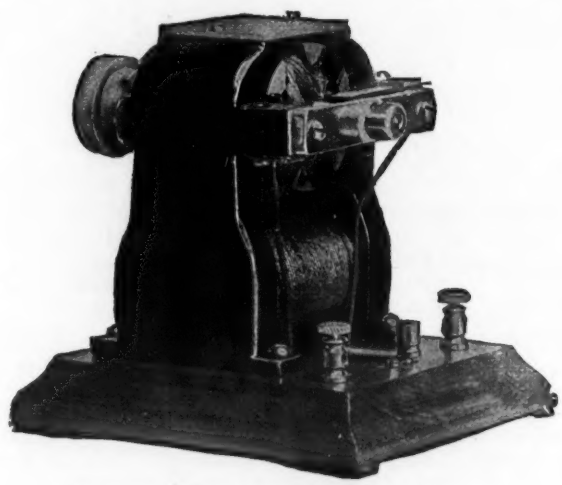
The electric street railway in Bamberg, Germany, which was built by Messrs. Felix Singer & Co., of Berlin, was opened officially on October 22 last. The trial trip was made in the presence of a royal commission of experts from Munich, Nuremberg and Bayreuth, and was a perfect success. The road is equipped with Walker Company apparatus, which, it is stated, attracted considerable attention by those present at the opening of the line, and familiar with electrical machinery. The opening of the road was celebrated amid festivities and considerable enthusiasm. Herr Felix Singer, president of the Berlin Electrical Company, acted as the motorman, and the newspaper, *Bamberger Neueste Nachrichten*, speaks in a very complimentary manner of the line and its equipment. It makes particular note of the fact that the steep grade and sharp curves on the way to the Kaulberg, which are quite severe, form no obstacle to the progress of the electric cars. The motor car traveled up the incline at the City Hall and took all the other grades with ease. During the descent the electric brake worked excellently. "Through these trials," the paper adds, "the electrical equipment of our railway has proved the fine workmanship and technical knowledge of its builders." The power house of the company is a complete establishment of its kind, and it is stated that neither thought nor money has been spared in making it of the highest class.

In this connection it is interesting to note that up-to-date electric railways are now in operation in Cairo and Alexandria, Egypt. The line in Alexandria, which runs to the town of Mex, was formally opened on September 11 last, in the presence of the Khedive and his court, the Sovereign himself riding next the motorman on the first car to go over the line. On the following day the line was thrown open to the public and over 8000 people took advantage of the opportunity to ride on the strange new cars. The rolling stock at present consists of ten motor cars, each equipped with two 25-hp Walker motors, and the power house contains two 125-kw direct-current Walker railway generators. The reports of the trial published in the French papers declare it to have been most successful.

Drum Armatures for Battery Motors.

Battery motors have not received particular attention lately with reference to improvements in their design in order to render them more efficient machines, but the Kent Electric Manufacturing Company, Worcester, Mass., has recently taken the matter up and improved its machine by the substitution of a drum armature for that of the common three-pole type. Efficient machines certainly should be used where the source of current supply is a battery, for the reason that the supply is limited and the best possible use of it should be made.

The illustration shown herewith represents the Kent motor, or dynamo, fitted with a drum armature. The armature is 2½ inches in diameter by 1¾ inches long, and has a magnetic cross section of 3 square inches. The employment of this type of armature in a battery machine gives a more effective distribution of the torque and avoids the rattling which is frequent in some three-pole ar-



BATTERY MOTOR WITH DRUM ARMATURE.

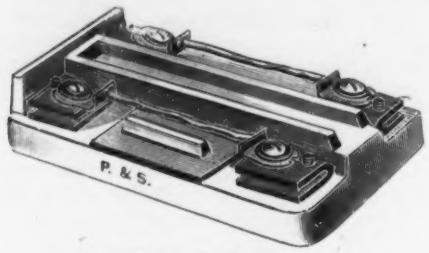
mature machines. With the latter type of armature the torque is unevenly distributed at the different positions in a revolution, and when the machine is loaded it very often becomes noisy, and consequently causes extraordinary wear on the bearings.

This drum armature machine will run as a dynamo. Another feature of its design is the adoption of the self-oiling bearings. The oil chamber just below the shaft contains a wick saturated with oil, which lubricates the bearings. Altogether, the machine is a well-made one, and should meet with popular favor. No doubt where the use of a battery is convenient and desired this machine will be found to be very useful and give satisfaction.

Improved Cut-outs.

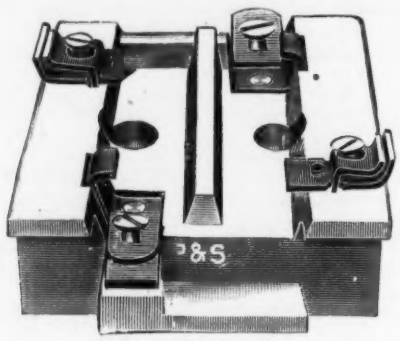
It will be remembered that Messrs. Pass & Seymour, Syracuse, N. Y., some time ago put on the market main and branch cut-outs which possessed the merits of safety and efficiency. These have been improved since then, the new forms being illustrated herewith.

The covers of the same capacity of main and branch cut-outs are inter-



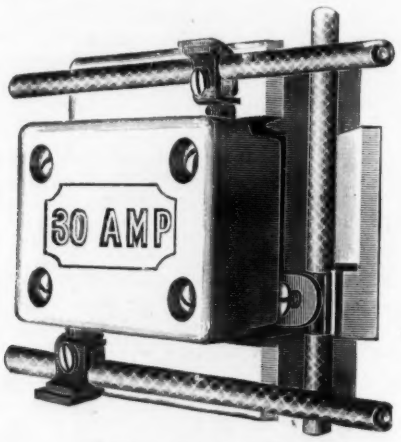
Cut-out Cover.

changeable; they are also readily detachable, and as they contain the fuses the circuit is thrown out when the cover is taken off. New fuses are easily replaced, and at the same time it is stated that danger of shock is avoided. The brass plates on the cover are bent in the form of the letter U, and when the cover is placed upon the base these plates slide on each side of the contacts on



Branch Cut-out.

the base. A half turn applied to the screws on the top of the cover when the latter is in position draws the sides of the plates together and causes them to tightly clamp the contacts. It will be noticed that the contacts for the wire are in the form of clamps. The main cut-outs are particularly adapted to telephone work, and are extensively used for that purpose.



Main Cut-out.

The porcelain used by this company has the reputation of being of the most excellent quality, and possessing great strength. The body is thoroughly vitrified, tests having shown practically no absorption. The glaze will not check nor craze.

A New Dry Cell.

The many advantages of the dry cell form of battery over its time-honored predecessor, the liquid or wet cell, are well known. It is portable, and, as made now, has a reasonably long life. Its portability is, of course, its principal feature.

Mr. William Roche, of New York, during the past nine years, has made over 1,250,000 cells of dry battery, and this extensive experience is now being utilized for the benefit of a new business just established by himself. Mr. Roche, it is stated, is the inventor of the Exeter dry battery, which became celebrated in 1893 through its use in connection with the opening ceremonies of the World's Fair. He also produced another well-known dry cell, which is one of the most popular in the market at the present time.

Mr. Roche has just undertaken the manufacture of dry cells on his own account, with headquarters at 259 Greenwich Street, New York. The "New Standard" cell represents the results of his long experience, and he feels confident that it is superior to any on the market. He is making two sizes, No. 1 and No. 2, the dimensions being 6 x 2½ inches, and 6¼ x 2½ inches, respectively. The E. M. F. is said to be 1.48 volts, and the amperage, 12 to 15 amperes on short circuit. Mr. Roche claims for his cells a life of two years on ordinary open circuit work. He recommends the No. 1 size as the standard; anything larger, he states, involves waste.

Röntgen Ray Apparatus.

Among the pioneers in the X-ray field are Messrs. Willyoung & Co., of Philadelphia, who, in the course of their experience in this new line of investigation, originated a number of novel features in the construction of X-ray apparatus. Chief among these may be mentioned their adjustable condenser and the "Ideal" vibrator.

In the 1898 types of apparatus produced by this firm, the vibrator used is an independent one of the Willyoung type. The current in the coil proper may thereby be varied through any range without in any way affecting the character of the break. To change the rate of break requires merely the adjustment of a small bob. The apparatus, in addition to the usual spark gap in parallel with the tube, is also equipped with a series gap, which is in series or tan-

Röntgen Ray Outfit.

dem with the tube. This arrangement not only gives a fine regulation of the amount of energy expended in the tube, but also serves to damp out the discharge at make, which, if allowed to take place would blacken and eventually destroy the tube. Both these spark gaps are adjustable.

An improved interlocking switch affords protection to the apparatus. This switch controls the vibrator and the coil. By its use the coil circuit can only be closed after the vibrator circuit is closed, and must always be opened before. Therefore the coil cannot be short-circuited or burned out. A safety fuse protects the apparatus from the danger of burn-out from excess of current.

The Willyoung apparatus is made for either battery or 110-volt circuits, and is also manufactured in a variety of styles for different uses, such as office, outdoor and hospital practice.

In the hospital outfit the coil proper is concealed permanently within the cabinet, the various manipulative devices, including spark points, condenser switch, vibrator, fuse, etc., being the only parts exposed to view. These are handsomely finished and present a rich appearance in contrast with the cabinet, which is of polished cherry. A plate glass top encloses these parts when the apparatus is not being used. The whole cabinet is mounted upon 3-inch casters, with heavy rubber tires, and may be quickly and noiselessly pushed about.

Mr. James G. Biddle, 910 Drexel Building, Philadelphia, Pa., is the selling agent for the Willyoung apparatus.

NEWS OF THE WEEK

Financial Intelligence.

THE BROOKLYN HEIGHTS RAILROAD COMPANY in its report for the quarter ending September 30 shows gross earnings of $1,211,892, an increase of $22,021, as compared with those of the corresponding period last year; operating expenses, $717,400, an increase of $43,893. The net earnings decreased $21,872, and the surplus increased $4706.

THE NASSAU ELECTRIC RAILROAD COMPANY, of Brooklyn, reports for the quarter ending September 30, gross receipts, $633,041, an increase, as compared with the gross receipts during the corresponding period of last year, of $81,871; operating expenses, $312,217, an increase of $33,136. The net earnings increased $48,735, and the increase in surplus amounted to $10,123.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Nov. 22, 1897.

MR. R. E. RICHARDSON, of the firm of Pierce & Richardson, consulting engineers, Chicago, Ill., paid New York a visit during the week.

THE NEXT CONVENTION of the National Association of Fire and Police Telegraph Superintendents will be held in Elmira, N. Y., August 15, 1898,

A SUBSTANTIAL GIFT.—The E. P. Allis Company, Milwaukee, Wis., has donated to Columbia University the complete equipment for a steam engineering laboratory. This gift is made in memory of the late E. P. Allis.

PAYMENT OF STREET RAILWAY PERCENTAGES TO THE CITY.—On November 18 the Metropolitan Street Railway Company paid to Comptroller Fitch $150,000, representing the percentage of gross earnings on the Broadway line for the year ending September 30, 1897. Percentages on other lines owned and controlled by the same company were also paid at the same time. They amounted to $208,649.19.

AMONG THE VISITORS IN NEW YORK within the past few days were Messrs. William H. McKinlock and W. C. Camp, of Chicago. Mr. S. L. Hadley, secretary of the Commercial Electric Company, Indianapolis, Ind., also paid New York a visit during the week. He reports that his company is doing a very satisfactory business, and has plenty of orders on hand to keep the works busy for a long time to come.

A CELL OF DRY BATTERY was the cause of a great deal of alarm and uneasiness to Policeman Roberts, of the New York police force. That officer of the law a few days ago picked up on an uptown street what appeared to him to be a bomb. Very carefully the suspicious-looking object was carried to the station house, and then to the Bureau of Combustibles at Fire Headquarters. There it was found to be nothing more than a cell of dry battery, which some one had lost in the street.

BRIDGE TRACK WORK ENJOINED.—On November 18 an injunction was granted by Justice Smith in the Supreme Court in Brooklyn restraining the Brooklyn Heights Railroad Company from continuing the work of building a curve on its line at Prospect and Adams Streets, Brooklyn. This injunction is based on the recent decision of the Court of Appeals, in the Kingston case, that one railroad company cannot use the tracks of another. The plaintiff in the Brooklyn case is a property-owner named Charles Kunz, and the papers are made returnable November 22.

LAYING A SHIP-NEWS CABLE.—During the present week the cable steamer "Mackay-Bennett," of the Commercial Cable Company, will lay a submarine cable from Coney Island to Sandy Hook. A cable will also be laid from Sandy Hook to Fire Island, and land-line connections will be established between Fort Wadsworth, S. I., and the Highlands of the Navesink. Three marine observatories on the Eiffel Tower plan, each 80 feet high, will be constructed by the company, one of them at the Highlands, another at the point of Sandy Hook and the third at Fire Island. It is the purpose of the Commercial Cable Company to enter the field of reporting ship news, which has hitherto been monopolized by the Western Union Telegraph Company. This service has always been very profitable to the Western Union Company.

TELEGRAPHERS' MUTUAL BENEFIT ASSOCIATION.—The annual meeting of this association was held in the Western Union Building, 195 Broadway, this city, on Wednesday afternoon, November 17. The reports of the president, secretary and treasurer showed the association to be in an excellent and flourishing condition. The proposed amendment to the constitution having for its object the admission to membership of former employees in the telegraphic service, providing they are otherwise qualified, was considered, and after some discussion, the matter was referred to the Executive Committee, with instructions to report at the next annual meeting. Mr. W. C. Humstone, superintendent of the Western Union Telegraph Company, was elected president, and Mr. A. R. Brewer, secretary of the same company, was elected treasurer. The meeting adjourned in time to enable the members to attend the dinner of the Magnetic Club, which was held at the Cadillac Hotel the same evening.

PROMOTING THE USE OF ELECTRIC CURRENT.—Touching the subject of the paragraph published in THE ELECTRICAL WORLD of November 13, in reference to the recent adoption of new discounts by the Edison Illuminating Company of New York, it is interesting to note that the directors of the company have authorized reductions in the prices of current as fast and as far as the margin above a fair dividend permits. It is their belief that such reductions will broaden the company's field of operations, insuring continuing increase of its success, and make possible still further reductions. The reductions so far made as was noted, have been chiefly to wholesale consumers, but particularly for long-hour use. For long-hour users the company is prepared to supply a mechanical meter with a recording dial, which can be read by the consumer. The company is also supplying its consumers Edison incandescent lamps, which are made under close specifications, adopted by the Edison illuminating companies during the past year. Lamps constructed under these specifications are said to be of the highest economy and longest service. There are now over 1200 enclosed arc lamps in operation on the company's system, and a great improvement has thereby been effected in arc lighting. Another interesting fact is shown in the company's circular letter. There are now connected with the company's system over 18,000 horse-power in motors. The motors, however, are generally supplied by the customers themselves, and not by the company, as was erroneously stated in the former article. All of the motors are the property of the customers. The company is now supplying its customers from five central stations and two annex stations, which include three storage batteries, each of these sources feeding into the same network of mains.

NEW ENGLAND NOTES.

BOSTON, Mass., Nov. 20, 1897.

MR. BURTON LEONARD LAWTON, treasurer of the Connecticut Telephone & Electric Company, Meriden, Conn., was united in marriage November 18 to Miss Grace Warner Boardman, of East Haddam, Conn. The wedding was in every respect a brilliant event. Our best wishes attend Mr. and Mrs. Lawton for a future of uninterrupted happiness and prosperity .

THE SESSIONS FOUNDRY COMPANY, Bristol, Conn., completed last week a 32-ton casting, to make which was required 35 tons of molten metal, and it was made as readily and as successfully as the smallest casting. The Sessions Company is certainly the largest in this country of its particular kind, if not the largest in the world, and its mammoth plant at Bristol is in truth a revelation of splendid machinery, all possible facilities and workmen trained for good and quick work, be it large or small. For years the electrical trade has evidenced liberal appreciation, and the many advantages of the new plant naturally attract increased appreciation. The business of the Sessions Company continues to grow, but Mr. W. E. Sessions, who is in direct charge of the works, seems to be equal to all demands and emergencies.

THE EDDY ELECTRIC MANUFACTURING COMPANY presents every evidence of business activity at its works at Windsor, Conn. Its large factory force is kept at work until 9 o'clock at night, and if orders continue to come in as they have for some time past, a night as well as day force will become necessary. Mr. A. D. Newton, treasurer and manager, says that the company has never been as busy as during the past three months. No better testimony than this could be given of the growing popularity of the excellent apparatus manufactured by this well-known company, and it hardly need be stated that such happy conditions are thoroughly deserved. Greater care is exercised by no company in the manufacture of electrical apparatus, nor is any company in this respect better qualified. Messrs. Eddy and Corson, in charge of this department of the Eddy Company, are untiring in their efforts to perpetuate and even improve the important features of the company's motors and generators, which, from the executive standpoint, Mr. Newton personally supervises very carefully every detail in order to give satisfaction to customers. To this is to be added, of course, the well-directed energies of genial M. E. Baird, who is almost continually on the road, keeping in touch with customers, and the popular and wide-awake agency corps—Mr. Coho, in New York; Mr. Angier, in Boston, and the others. Certainly a strong combination of conditions and advantages for continued success.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., Nov. 20, 1897.

THE BUFFALO TRACTION COMPANY has filed with the city a bond of $200,000, given to the Lawyers' Surety Company, of New York, to take the place of individual bonds. It covers the company's liability under the franchise obtained from the city.

ELECTRIC POWER IN FLOUR MILLS.—Buffalo flour milling companies are all applying for electric power, and the Urban Milling Company is figuring on electrical apparatus to change over from steam to electric power. The Black River Mill of the Banner Company will be operated by electric power as soon as the wires can be put in.

SECRETARY CHARLES R. HUNTLEY, of the Power & Conduit Company, states that he is preparing to give Buffalo a flat rate for house lighting, which he is sure will be acceptable. He declares that power from Niagara Falls will enable his company to offer much lower rates than those existing. He complains that Buffalo is rather apathetic and inclined to look with suspicion on the cost, but he is prepared to bring it down to that of gas and, with economy,

he says, it might be made still lower. The chief difficulty at the outset is that so few houses are wired for lighting, and where wires have been put in they are usually too small and often of poor insulation.

Pittsburg Notes.

Pittsburg, Pa., Nov. 22, 1897.

NO ACTION YET FOR THE HOME TELEPHONE COMPANY.—At the meeting of Select Council in Allegheny, on November 17, the ordinance granting a franchise and rights of way to the Home Telephone Company was laid on the table for thirty days longer. It is understood that this further postponement of action was requested by the company.

NEW STREET RAILWAY COMPANY CHARTERED.—A charter has been issued at Harrisburg to the West End Traction Company, of Pittsburg. The incorporators are: J. C. Reilly, W. J. Burns, Thomas S. Bigelow, J. D. Callery and W. V. Callery, all of Pittsburg. The object of the new company is to bring under one organization and management all the lines running to different points in the Chartiers Valley. These lines are a part of the great Second Avenue Company's system, with which the incorporators of the new company are prominently identified.

ELECTRIC LIGHT PLANT FOR CORAOPOLIS.—On October 20 bids were received by Mr. Junius D. McCabe, Pittsburg, Pa., borough engineer, for an electric light plant for the borough of Coraopolis. The specifications called for a brick building 24 feet by 35 feet, one 150-hp automatic engine, one 60-kw single-phase alternator, with a 1½-kw exciter, and about 5 miles of pole line, with circuits erected, all constructed complete and in running order. Three bids were received, as follows: W. F. Patterson, Pittsburg, $5514; Russell & Co., Pittsburg, $5990, and John E. Ridall, Pittsburg, $7285. The contract was awarded last week by the Borough Council to W. F. Patterson. The work is to be completed within sixty days.

NEW BRIDGES FOR THE CONSOLIDATED TRACTION COMPANY.—Work was started last week by the Schultz Bridge Company on the new bridge crossing the Pennsylvania Railroad tracks at Shady Avenue. As soon as this bridge is completed the construction of similar ones on Highland Avenue and on Penn Avenue will be started. The cost of these structures is to be borne jointly by the city and the Consolidated Traction Company. The present bridges on Shady and Highland Avenues are not strong enough to carry the heavy cars of the Consolidated Traction Company, and in consequence it has been obliged to defer the application of its "loop" system of running cars on those thoroughfares until the new bridges are built.

UNITED TRACTION COMPANY'S ORDINANCE.—The ordinance granting a ninety-nine-year franchise to the United Traction Company was finally passed by Select Council in Allegheny, on November 17, and by Common Council on the following night. The ordinance was bitterly opposed for months, on the ground that it contained no stipulation for free transfers between the various lines of the system. The company promises to give the desired transfers, but absolutely refused to accept an ordinance containing any provision compelling it to do so. Several attempts were made to amend the ordinance by the insertion of a free transfer clause, but these ended in failure, and the ordinance was finally adopted in the shape demanded by the traction company. One of its provisions is that the city is to receive 2 per cent. of the gross receipts of the company.

Chicago Notes.

Branch Office of The Electrical World,
936 Monadnock Building,
Chicago, Ill., Nov. 19, 1897.

THE OCCIDENT CLUB gave a very entertaining musicale in its rooms in the Western Electric Company's Building, in this city, on November 13 last.

A FORMAL TRIAL of the new electric system which is being installed on the South Side Elevated Railroad, in this city, was made on the afternoon of November 12, in the presence of Mr. Frank J. Sprague and officials of the company. The test was pronounced a success in every respect. It is stated that the electric system will be ready for operation before the end of February next. The motors and other apparatus are being made at Schenectady, N. Y., and the remodeling of the cars is being done by the Wells & French Company, of this city.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Chicago, Ill., is sending out a very neat and attractive little circular card of an independent public telephone pay-station sign, made after its own design. It is certainly a very appropriate and attractive sign for the independent telephone business. It is made of the best charcoal iron, with heavily baked enamel. Both sides have the American shield in a large, white block at one end, with the original thirteen stars in a blue field, and red and white stripes, with the word "Independent" in bold letters across the face of the shield. The main part of the sign is of a blue ground, with the words "public telephone pay station" in large white letters. The sign is made with a flange for fastening against a wall or post, and holes for suspending. It has no mark of the manufacturers, and is intended expressly for independent public telephone exchanges.

Milwaukee Notes.

Milwaukee, Wis., Nov. 19, 1897.

THE MONROE COUNTY TELEPHONE COMPANY, Monroe, Wis., has been incorporated, with a capital stock of $8000.

ONE OF THE LARGEST CEDAR CONTRACTS of the year has just been let at Marinette, Wis. The Central Union Telephone Company, of Chicago, accepted the bid of the Pittsburg & Lake Superior Iron Company to furnish 60,000 telephone poles. The contract aggregates over $100,000, and must be filled within a year.

A TELEPHONE COMPANY is being organized at Eau Claire, Wis., with a capital stock of $250,000, and will build lines over Eastern Wisconsin and the Northern Peninsula of Michigan. It will connect with the Wisconsin Valley Telephone Company's line. The new company will be known as the Chicago Northwestern Telephone Company.

AN ELECTRIC STREET RAILWAY is talked of in Oconomowoc, Wis. The Oconomowoc Advancement Association is canvassing the town to ascertain the sentiment. The line would join the Milwaukee Electric Railway & Light Company's branch at Waukesha. As such a plan might injure the retail business of Oconomowoc, opposition to the line has developed.

St. Louis Notes.

St. Louis, Mo., Nov. 13, 1897.

NEW INCORPORATION.—The National Telegraph & Messenger Company has filed articles of incorporation, with a capital stock of $2000. The incorporators are William R. Knox, J. F. Carr and P. White.

CHEAPER TELEPHONE SERVICE.—Messrs. J. J. Downey and C. E. Rope are negotiating with Belleville people to build a new telephone system. They promise lower prices than those charged by the Bell Company, and a connection with the Kinloch system in St. Louis. The City Council will be urged to grant the franchise.

THE MIXED CONDITION of the local street railway situation in this city, caused by the introduction of numerous street railway bills in the Council, has caused a marked decline in the stocks and bonds of local street railway companies. The Lindell stock has declined from $137½ to $125, and that of the Suburban Company from $56 to $45.

TO CREVE CŒUR.—Active construction work will begin in a day or two on the Lindell Railway Company's Creve Cœur Lake 14-mile extension. Surveyors and engineers are now preparing the specifications. The section of the road to be constructed will be 7 miles long. Five miles of track are already laid. The entire line will be finished this winter.

A NEW POWER PLANT.—Three sets of plans were drawn up by as many engineers for the power plant of the Citizens Electric Light & Power Company, of this city, and these have been combined in one, all the good points of each being utilized. The plant will be so constructed as to admit of ready extension, and will be built on the most modern lines. It will be located on the river front.

THIRD RAIL EXPERIMENT.—An informal test of the new third-rail system was made last Saturday at Forsyth Junction on the St. Louis, Kansas City & Colorado Railway, and it proved successful. The third rail is laid upon the surface, and is fed by a feeder wire, which runs underneath. The current is conveyed from the third rail to the motors by means of a shoe. A number of prominent railway men were present at the test.

IN FAVOR OF UNDERGROUND TROLLEYS.—A resolution was introduced at a recent meeting of the Board of Public Improvements requesting the president of the board to obtain information as to the feasibility of the underground trolley system in "certain cities." In view of the proposed street railroad construction in this city and the fact that the underground trolley system has been reported to be giving entire satisfaction in other cities, this resolution is evidence of the desire for the introduction of the underground trolley in this city in future work.

TWO RIVAL ELECTRIC ROADS.—The St. Lopis, Belleville and Suburban Railway Company has been incorporated for $350,000, to build a road between East St. Louis and Belleville, Ill. A single track will be laid within six weeks. One hundred men were put to work last Monday. The other road is the St. Louis & Belleville Electric Railroad, and is incorporated for $50,000. The line must be completed and in operation by July 1, 1898. The company has a private right of way. The tracks of the St. Louis & East St. Louis Electric Road will be used for part of the way. The road is to be double tracked throughout. The rails will be 60 feet long, and weigh 70 pounds to the yard. A handsome new power house will be built, with a capacity of 1500 to 2000 horse-power.

Texas Notes.

San Antonio, Tex., Nov. 18, 1897.

AN ELECTRIC-LIGHT PLANT is soon to be installed in the little town of Boerne, 30 miles north of here. A San Antonio firm has the contract for putting in the plant.

THE ALAMO HEIGHTS ELECTRIC STREET RAILWAY, of this city, owned by the Franklin Trust Company, of New York, has been in the hands of a receiver for some time. Mr. W. H. Hume, the receiver, states that the receivership will soon be dissolved.

THE SURVEY for the electric railway that is to connect Houston and Galveston is completed, and it is stated that the line will assuredly be built. The distance between the two cities is only 50 miles. The proposed line will pass through the town of Dickinson, which has for three or four years maintained a coast country fair and exposition and race meeting.

MAJOR R. B. BALL was on November 12 appointed receiver of the Gulf City Street Railway Company, of Galveston, his bond being fixed at $25,000. His appointment was made upon application of the Guarantee Trust Company, of New York. This road was absorbed seven years ago by the Galveston City Street Railway, of which Major Ball was appointed receiver a month ago.

THE CITY COUNCIL of this city has granted a franchise to the Merchants & Manufacturers Transportation Company for the use of certain streets as an electric freight-car line. The line will be used by the San Antonio and the Lone Star Brewing Associations for the transportation of railroad freight cars between the breweries and the railroads. The stock in the transportation

company is all held by the San Antonio Brewing Association. The electric motors for the line have already been purchased and have arrived here.

IT IS ANNOUNCED that the cities of Sherman and Denison, having a combined population of about 30,000, are to be connected by an electric line. They are situated about 10 miles apart. The projectors of the enterprise have purchased a tract of land about midway between the two towns, which will serve as the location of the power house, car shops and terminal facilities. The citizens of the two places have gotten together and organized a county fair and racing enterprise, and handsome grounds will be fitted up near the midway tract for the holding of these amusements.

THE FIRST ELECTRIC RAILWAY IN THE CITY OF MEXICO.—In the issue of THE ELECTRICAL WORLD, dated November 13, brief reference was made to the fact that a syndicate of London capitalists controlling the street railway in the City of Mexico had given instructions to the general manager to equip the line with electric power. Preliminary plans for the work are already in progress, and the actual construction will begin as soon as these plans are completed. The extensive street railway system in the City of Mexico was purchased from its Mexican owners about two years ago by a London syndicate, the price paid being $8,000,000 in Mexican silver. Mr. Thomas H. McLean, the well-known street railway manager, was brought from Indianapolis, Ind., by the syndicate, and its property placed in his hands as general manager. The system embraces 157 miles of track. All of the lines were in a deplorable condition when the English owners took possession of the property, and they have already expended $7,400,000 in Mexican silver in substantial improvements. The company at the present time employs 1437 men on its lines, and works 4700 mules. The conductors receive as wages $1 and the drivers 75 cents per day. The road or construction laborers receive 44 cents a day. The number of cars in daily service is 343, 180 of this number being reserved for funerals and special service.

FRENCH NOTES.

(From Our Own Correspondent.)

PARIS, November 7, 1897.

HIGH-POTENTIAL TRANSFORMER.—M. Octave de Rochefort has recently presented to the Society of French Civil Engineers a transformer for very high potentials, which he has designed in collaboration with M. Wyds. This instrument was constructed to replace the classic Ruhmkorff coil for the production of Röntgen rays. The construction of the transformer is very simple, and its efficiency said to be so high that a much greater output for the same volume can be had from it than from ordinary coils. A pasty solution of paraffin in petroleum is used as an insulation.

GAS LIGHTING CONTRACTS IN PARIS.—The industrial field is occupying itself considerably at present with a report recently made to the municipal council of Paris by M. C. Bos, municipal councilor, relative to the prolongation of the concessions accorded to Parisian electric illuminating companies, which expire in 1908—the same year in which expires the contract between the city of Paris and the gas company. The electrical companies demand, before consenting to a diminution of their tariffs for electric lighting, which are truly excessive—a kilowatt hour being sold at prices varying from 1.20 to 1.50 francs—a prolongation of their concessions. The report of M. Bos is favorable to the grant of such an extension, but it cannot be said at the moment that this will be accorded, the city of Paris, as things now stand, being absolutely free at the time of the expiration of its contract with the present gas company.

THE ZEEMAN PHENOMENON.—On November 6 M. Cornu made a most interesting and important communication to the Société Francaise de Physique on the subject of the phenomenon discovered at the beginning of the year by Dr. Zeeman of Amsterdam. After having shown the nature of the Zeeman phenomenon and indicated the results obtained by its discoverer, M. Cornu described the disposition of apparatus which permitted him to authenticate, with very great certainty, the doubling of spectral lines when observed along the direction of the lines of magnetic force, and the tripling of these rays when observed in a direction perpendicular to the field. In closing his communication, M. Cornu said he had sought by the aid of the apparatus and in the experiments described to discover if, in the phenomenon of magnetic polarization, there was not, as in that of Zeeman, a modification of the period of vibratory movement of light. The results of his efforts were negative. The action of the magnetic field upon light waves is different, according to whether the waves are in process of formation or already formed when the magnetic field is made to act upon them. In the first case, which corresponds to Zeeman's phenomenon, the action of the magnetism is upon the period of vibration; in the second, corresponding to rotatory magnetic polarization, it is the quickness of propagation which suffers a modification.

General News.

NEW INCORPORATIONS.

THE MONITOR ELECTRIC COMPANY, St. Paul, Minn., has been organized with a capital stock of $100,000. Among those interested are Tracy D. Hatch and A. D. Arundel.

THE ROCKPORT & GULF COAST TELEPHONE COMPANY, Rockport, Tex., has been formed with a capital stock of $2000. The incorporators are S. P. Sorenson, A. L. Bruhl, R. P. Bracht.

CHARLESTON ELECTRIC LIGHT COMPANY, Charleston, Mo., has been formed, with a capital stock of $20,000. The incorporators are J. H. Moore, J. P. Bridges, E. G. Rolwing, and others.

THE MISSOURI AUTOMATIC TELEPHONE COMPANY, St. Louis, Mo., has been organized. The incorporators are Charles T. Farrar, William Dean, Henry A. Coit, and others. Capital stock, $100,000.

THE ELDORADO LIGHT & POWER COMPANY has been incorporated at Sacramento, Cal., with a capital stock of $300,000. The incorporators are F. F. Smith, W. C. Hendricks, R. C. McCreary, T. A. W. Shock and J. G. Cunningham.

THE RASTER CARBON RHEOSTAT COMPANY, Chicago, Ill, has been formed for the purpose of manufacturing general electrical apparatus and goods. The incorporators are Edwin Raster, George W. Rogers, and Ferdinand Heiss. Capital stock, $10,000.

THE BRANT ROCK & DUXBURY BEACH ELECTRIC RAILROAD COMPANY, Brant Rock, Mass., has been organized. Among those interested are I. L. Currier, Worcester, president and treasurer; B. S. Brant, of Brant Rock, secretary, and others. Capital stock, $50,000.

THE AMERICAN INCANDESCENT LAMP COMPANY, Warren, Ohio, has been formed to manufacture electric lamps, machinery and appliances. The incorporators are I. E. Ackerly, Albert H. Kriestler, C. C. McNutt, Jr., Z. F. Crover and John J. Sullivan. Capital stock, $50,000.

THE WABASH & MISSISSIPPI CONSTRUCTION COMPANY, Salem, Ill., has been incorporated, for the purpose of building and operating an electric road from East St. Louis to the east line of Lawrence County. The incorporators are C. H. Neff, W. C. Irwin and A. N. Rooks. Capital stock, $2500.

THE SKAGUAY & LAKE BENNETT TRAMWAY COMPANY has filed articles of incorporation at Portland, Me. The incorporators are Henry E. Batti, Ensley A. Webster, Henry C. Ash and George H. Durham. The capital stock is $250,000. The object of the company is to build and operate a railroad from Skaguay, Alaska, over White Pass.

THE DELAWARE TERMINAL RAILROAD COMPANY, Sidney, N. Y., has been organized, with a capital stock of $150,000, for the purpose of building an electric railroad from this place to Franklin. The directors are Charles L. Burgess, Seigmund Myer, John Neff, New York City; Charles N. Fuller, Sidney; Lewis F. Raymond, of Franklin, and others.

THE SYRACUSE, SKANEATELES & MORAVIA RAILROAD COMPANY, Moravia, N. Y., has been incorporated, with a capital stock of $1,000,000, to build an electric railway from this place to Syracuse. President, W. T. Wing, Moravia; vice-president, Henry J. Hubbard, Skaneateles; secretary, Joseph Parker, Moravia; treasurer, Thomas W. Downing, Moravia.

THE CROSS COUNTY RAILROAD COMPANY was incorporated at Albany, N. Y., for the purpose of constructing a street railroad in Kings and Queen Counties, 15 miles long. The directors of the road are Joseph McLean, Andrew A. Halsey, Theodore Bernard, Charles H. Kelby, James Crowley, Francis Bacon, James Erwin and Charles Brandon. Capital stock, $250,000.

THE METROPOLITAN ELECTRIC LIGHT, HEAT & POWER COMPANY, New York, has been incorporated to produce electricity for light, heat and power, and for lighting, streets, parks, etc., in New York City. The directors are Albert Reynaud, of New Dorp, S. I.; Ernest G. Wightman, of Stapleton, S. I., and Robert Emmet, of New York City. Capital stock, $25,000.

THE LIMA & COLUMBUS ELECTRIC RAILROAD COMPANY has filed articles of incorporation at Columbus, Ohio, for the purpose of building an electric line to connect the two cities named. The incorporators are John M. Boose, Aaron Fisher, D. H. Sullivan, Jason G. Lamson, Smith H. Bracey, Arthur T. Welles, and Wilbur N. Horner. The capital stock of the company is $50,000.

THE TELEGRAPH AND TELEPHONE.

TECUMSEH, MICH.—Interested gentlemen are organizing a local telephone company, and the enterprise is already well under way.

DETROIT, MICH.—The long-distance service of the Bell Telephone Company is to be extended from Menominee to Escanaba and Ishpeming.

HOLLY, MICH.—The State Telephone Company is extending its line from Pontiac through Clarkstown, Holly and Fenton, to Durand and Owosso.

ALEXANDRIA, VA.—The American Telephone & Telegraph Company has asked the Council for permission to erect poles and string wires in this city.

LEXINGTON, KY.—The East Tennessee Telephone Company will build a line from Chattanooga to Lexington, where it will connect with the Cincinnati circuits.

DETROIT, MICH.—The project for the Houghton County independent telephone system has fallen through, the Bell Company promptly dropping its rates to those proposed by the new company.

GILBOA, N. Y.—Work on the new telephone line between South Jefferson and Sanford is progressing, and it is thought that the line will be extended to Ruth and Blenheim, thus affording connection with Albany.

STANLEY, WIS.—The Wisconsin Valley Telephone Company has accepted a franchise from the city and given its bond for the faithful execution of the same. Work on the new exchange will be commenced at once.

RANDOLPH, UTAH.—Construction work on the new telephone line to Evanston, Wyo., has been commenced. The distance is 94 miles. The new line is being built by a company composed of Evanston and Randolph business men.

BEDFORD, IND.—The long-distance telephone line between Indianapolis and Fresh Lick Springs has been completed. The line runs through this city, notwithstanding an injunction. It is probable that it will be extended to New Albany and Louisville by next year.

FLORENCE, ALA.—The Citizens Telephone Company, of this city, has made an assignment to M. B. Shelton, president of the Merchants' Bank, for

the benefit of its creditors. The exchange has been closed, and all the assets of the company disposed of. The cause of the company's downfall was insufficiency of its earnings.

EAU CLAIRE, WIS.—The Chicago-Northwestern Telephone Company is the name of a new concern just organized here for the purpose of building lines from Milwaukee to cover Eastern Wisconsin and Northern Michigan, and to connect with the Wisconsin Valley Telephone Company's system. The latter named company contemplates building about 1600 miles of lines in the territory bounded by St. Paul and Winona on the west, Ashland and Superior on the north, Wausau on the east, and Madison on the south. The construction work was commenced about thirty days ago, and since that time 300 miles of line have been built. The company will establish independent exchanges in all towns which have not such facilities.

Electric Light and Power.

RENO, NEV.—The city has voted to issue $150,000 in bonds for a water and light plant.

NORTH ENGLISH, IA.—J. W. Erwin & Son, merchants, propose to put in an electric light plant.

CLYDE, N. Y.—The Clyde Electric Light & Power Company will add another boiler and engine to its plant.

OCALA, FLA.—The City Council is agitating the question of issuing $36,000 worth of bonds for the purchase and erection of an electric light plant.

PHILADELPHIA, PA.—Mr. Henry Schadewald, Third and Huntingdon Streets, is ready to install a 300-incandescent light plant, including dynamo.

CUMBERLAND, MD.—At the recent election the Council was empowered to issue city bonds to the amount of $20,000 for the purpose of installing a municipal electric lighting plant.

NEWARK, N. J.—The installation of the People's Light and Power Company, of this city, will shortly be increased by eighteen 125-light Brush arc dynamos, having a total capacity of 2250-2000-cp arc lamps.

WASHINGTON, D. C.—Sealed proposals will be received November 30 for installing an electric light and power plant in the Post Office Building. Proposals will be received as follows: First, for tubing and wiring the building; second, for dynamos and engines; third, for the plant complete. Proposals must be accompanied by certified checks drawn to the order of the Treasurer, United States, as a guarantee of good faith. O. L. Spaulding, Assistant Secretary.

EAU CLAIRE, WIS.—The Eau Claire Lighting Company has been permanently reorganized, and elected George B. Wheeler secretary and manager. The new company will develop and increase the power plant. It is understood that it will make a special effort to put electric power on the market at a figure that will encourage the establishment of new manufacturing enterprises. The company proposes to increase its water power and add to its steam plant by putting in new boilers and larger engines.

OMAHA, NEB.—A notable change is about to be made by the new Omaha Thomson-Houston Electric Light Company here, in undertaking the concentration of its station. It has recently placed an order with the General Electric Company for three monocyclic alternators, each one to be directly connected to a compound condensing McIntosh & Seymour engine. These alternators will be revolving armature, forty-eight-pole machines, each of 300 kilowatts at 150 revolutions, and will be separately excited. They will take the place of a considerable number of smaller machines, and will be used to furnish current to an extensive system of three-wire secondary mains, fed from large transformers.

The Electric Railway.

LULING, TEX.—The Electric Street Railway Company, of this place, will extend its lines.

JERSEY CITY, N. J.—The Consolidated Traction Company will build a trolley from Greenville to Bayonne.

DUDLEY, MASS.—The Selectmen have granted a franchise to the Webster & Dudley Electric Railway Company.

NYACK, N. Y.—The Nyack Traction Company has petitioned the Board of Village Trustees to construct a street railway in the city.

JACKSON, TENN.—An electric-street railway and an incandescent electric lighting plant are to be built in this city by Chattanooga capitalists.

CLEVELAND, OHIO.—Work has been commenced in the construction of the Lima & Columbus Electric Railway, which was organized last week.

NEW ROCHELLE, N. Y.—The New Rochelle Electric Railway Company has petitioned the town for permission to operate an electric railway in this city.

BROOKLYN, N. Y.—It is said the Nassau Electric Railway Company will erect a large electric plant on Union Avenue, Broadway, Boerum and Lorimer Streets.

SPRINGWELLS, MICH.—The Detroit, Ypsilanti & Ann Arbor Electric Street Railway Company has been granted a franchise by the Township Board of this place.

PARKERSBURG, W. VA.—James M. Jackson, Jr., John Busch, C. C. Martin, H. H. Moss, and others, have been granted a franchise to operate an electric railway in the city.

NEW BRUNSWICK, N. J.—It is announced that the Brunswick Traction Company has obtained permission from the Piscataway Township Committee to extend its line from Bound Brook to Dunellen.

MARIETTA, OHIO.—Right of way for an electric road from Williamstown to Parkersburg is being secured. This has been long talked of, but is being pushed since the filing of plans with the War Department for the Marietta-Williamstown bridge.

TRENTON, N. J.—Application has been made to the Common Council of the city of Trenton by the Pennington Avenue Passenger Railway Company for the right to use certain streets in this city for the construction, maintenance and operation of a street railway.

BRIDGEPORT, CONN.—Paige & Carroll, attorneys for the Bridgeport Traction Company, have petitioned Judge Elmer, of the Supreme Court, for a hearing and finding upon the question of public convenience and necessity in the matter of the extension from Southport to Westport of the Traction Company's lines.

HOLYOKE, MASS.—The Mt. Tom Railroad was closed on October 31, to remain inoperative until May 1, next year. Extensive operations and improvements are now being made to the pavilion on Mt. Tom. It is the intention of the Holyoke Street Railway Company to have a searchlight on top of the mountain next year, but arrangements for this feature have yet to be made.

Trade and Industrial Notes.

THE GENERAL ELECTRIC COMPANY during the months of June, July and August received orders for 278 generators, aggregating nearly 14,000 kilowatts, for lighting purposes alone.

GAS ENGINES FOR PURDUE UNIVERSITY.—Messrs. Van Horne, Burger & Co., Dayton, Ohio, have received an order for one of their "Van" gas engines to be used in the experimental station at Purdue University, Lafayette, Ind.

AN ORNAMENTAL ENCLOSED ARC LAMP is being placed upon the market by the Western Electric Company, of Chicago. This lamp is similar in style to the company's standard enclosed arc lamp, but finished in polished brass. The features of the new lamp have placed it in the front ranks.

THE NORWEGIAN MICA COMPANY is a recent organization formed in Christiania, Norway, having for its object the development of mica mines in Norway. The president of the new company is Henry E. Mohn, a civil engineer of Christiania, and the Board of Directors consists of the president and Johan H. L. Vogt, professor of mineralogy at the University of Christiania.

HIGHEST HONORS FOR LEATHER BELTING.—We are informed by Messrs. Charles A. Schieren & Co., the well-known manufacturers of leather belting, New York City, that they have been awarded the diploma of honor with gold medal at the Tennessee Centennial Exposition, which was held in Nashville last summer, and closed October 31 last. It is stated that very few gold medals were issued and awarded.

THE JANDUS ELECTRIC COMPANY, of Cleveland, Ohio, has purchased of the Manhattan General Construction Company, of New York, all of the latter's stock in the Jandus Company, and thus the litigation between the two companies has been settled and adjusted. The Jandus Company will now manufacture and sell the Jandus lamp, while the Manhattan Company will soon put on the market a new lamp of its own, known as the Manhattan lamp.

THE AUTOMATIC CIRCUIT BREAKER COMPANY'S plant at Newaygo, Mich., has been sold under first mortgage, and was purchased by the Furniture City Electric Company, Grand Rapids, Mich. It is stated that the plant will be at once removed to Grand Rapids, where will be continued the manufacture of the automatic circuit breaker, formerly conducted by the company first named. This will form a part of and an addition to the present business of the Furniture City Electric Company.

FUSING JUNCTION BOXES.—As regards the safety of fusing the porcelain junction fuse boxes for primary circuits, made by Messrs. Pass & Seymour, Syracuse, N. Y., it is interesting to note a reference made in a letter recently received by that firm. The writer states that the process of fusing can be carried on with perfect safety in wet weather. Where iron boxes are used the whole pole is charged after blowing a few times. The writer, to further testify as to his appreciation of these valuable qualities, gave an order for twelve more of the boxes.

FIRST IMPRESSIONS ARE OFTEN MISLEADING.—The recipients of a circular from the Central Electric Company, Chicago, headed "$100 Reward," and bearing a picture of one of its salesmen, and in other ways an imitation of the circulars sent out by the detective agencies, may be originally impressed by the fact that "another good man has gone wrong." A more careful reading, however, discloses the fact that between the lines it is a clever exposition of the virtues of the salesman referred to, and an excellent advertisement for the Central Electric Company, as well as its representative.

THE STANDARD UNDERGROUND CABLE COMPANY is sending out a circular letter calling the attention of those interested to what it believes to be an unauthorized use by other manufacturers of certain patented inventions owned and controlled by that company. A suit involving these patents was briefly referred to in The Electrical World of October 30. The Standard Company states that its object in calling attention to these patents is chiefly that all persons interested in such matters may be duly advised, and with the hope that in making purchases its rights thereunder will be respected.

THE AMERICAN ENDOSCOPIC COMPANY, Providence, R. I., manufacturer of high-grade decorative and miniature lamps, has just issued a very artistic little catalogue of its products. Some very excellent illustrations of the various styles of lamps manufactured by this company are shown. The size of these lamps range from the cystoscope lamp, which is the smallest made, to special sign lamps. The company manufactures a complete line of lamps for surgical and dental uses. These are said to be the best lamp ever shown to the profession. The company has given much time and spared no expense in the fitting up of its lamp department, and claims to make only the finest of lamps. The company's small lamps can be reliably used with dry cells.

THE ADVANTAGES of the ironclad feature in motor construction are being

recognized more and more, and the demand for this class of machine is a constantly increasing one. It is very often necessary to place motors in positions where moisture, dust, gases, etc., would prove injurious to a machine of the ordinary type. The closed-type, slow-speed, ironclad motors manufactured by the C & C Electric Company, New York, are so designed as to meet all peculiar requirements as to location of such machines. The C & C machines can be placed anywhere desired without danger, and no housing about them is needed. When necessary, two bearings may be bolted to the frame of the motor, carrying a shaft fitted with gears, forming a very efficient back-gear, slow-speed outfit. It is stated that these motors are being extensively used by manufacturers of various types and classes of machines requiring a direct-connected motor.

AWARDS FOR MACHINE TOOLS AT THE BRUSSELS EXPOSITION.—The following is a list of the awards made at the Brussels Exposition in the section of machine tools. The "Grand Prix," or highest possible distinction, was awarded to three concerns, one foreign and two American. The American companies are the Brown & Sharpe Manufacturing Company, Providence, R. I., and the Pratt & Whitney Company, Hartford, Conn. The prize of next degree, a gold medal, was awarded to eight foreign and nine American competitors. The American firms were the following: Cincinnati Milling Machine Company, Cincinnati, Ohio; Gould & Eberhardt, Newark, N. J.; G. A. Gray Company, Cincinnati, Ohio; J. Becker Manufacturing Company, Fitchburg, Mass.; Morse Twist Drill & Machine Company, New Bedford, Mass.; Norton Emery Wheel Company, Worcester, Mass.; Prentice Brothers, Worcester, Mass.; Bullard Machine Tool Company, Bridgeport, Conn.; Warner & Swasey, Cleveland, Ohio. The silver medal was awarded to eight foreign and nine American competitors, and the bronze medal to four American houses.

Business Notice.

A NEW THROUGH PASSENGER ROUTE FOR COLORADO, UTAH AND CALIFORNIA.—The Chicago *Times-Herald* of August 27 says that on September 12 the new traffic alliance between the Chicago, Milwaukee & St. Paul Railway and the Chicago, Rock Island & Pacific Railway goes into effect, and on that date the former will send its first Denver sleeper out of Chicago. This will be attached to its regular night train for Omaha, and will be delivered there to the Rock Island. On October 2 the tourist car route over these two lines, the Colorado Midland and Southern Pacific, will be inaugurated. Tourist cars will be run once a week between Chicago and San Francisco. For further details regarding this new route call on or address E. F. Richardson, General Agent Passenger Department, C., M. & St. P. Ry., 381 Broadway, New York City.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOVEMBER 16, 1897.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

593,559. STORAGE BATTERY; E. A. Barber, Watertown, N. Y. App. filed May 14, 1897. A storage battery, comprising in combination a stack of trays, each of which has on opposite sides of its bottom portion an integral compartment plate, the compartments in which contain the active material, insulating strips on the upper edges of the outer and central dividing walls of the compartment plates, the asbestos sheets resting on the said strips, the lower surface of each plate resting on an asbestos sheet, the positive and negative plates at the top and bottom of the trays respectively, and electrical connections therewith.

593,611. MULTIPLE SWITCHBOARD SYSTEM FOR TELEPHONE EXCHANGES; C. E. Scribner, Chicago, Ill. App. filed May 13, 1892. The combination, with a telephone line and spring jacks connected therewith in a switchboard, a repeating coil and a line annunciator, a bridge of the line circuit, including one helix of the repeating coil, and a local circuit including the other helix of the repeating coil and the line annunciator.

593,612. TOLL COUNTER FOR TELEPHONE LINES; C. E. Scribner, Chicago, Ill. App. filed Sept. 10, 1894. The combination, of a permanent magnet, of an armature therefor, having projections adapted to come successively into the field of the magnet, an electromagnet and means for intermittently exciting the same, and an armature for the electromagnet connected with the armature of the permanent magnet, the poles and armature of the electromagnet being so adjusted with relation to the poles and armature of the permanent magnet that the attraction of its armature by the electromagnet beings a new projection of the armature of the permanent magnet into the field of the latter.

593,613. POLARIZED SIGNAL BELL; C. E. Scribner, Chicago, Ill. App. filed Nov. 25, 1895. The combination, with a telephone line, including a local storage battery in the line at a sub-station and a charging battery therefor, and provided with means for producing alternating currents in the line, of an electric bell, whose electromagnet is provided with two different windings in different parallel branches of the line circuits, one of which branches is constructed to have high impedance, whereby the bell remains neutral to the charging current, but may be operated by alternating current.

593,614. TELEPHONE SYSTEM; C. E. Scribner, Chicago, Ill. App. filed Sept. 25, 1896. The combination, with a telephone line having a transmitting telephone and an induction coil at its sub-station, and terminating in an appliance for establishing connection with another telephone at a central station, of a supply circuit distinct from the line permanently including the said transmitting telephone and the primary winding of the induction coil at the sub-station, and terminating in a separate contact piece of said appliance, a source of current at the central station, a switch contact forming the terminal thereof, and means for applying said switch contact to the contact terminal of said supply circuit in the act of making connection with the line.

593,625. INSULATED HANGER; E. P. Warner, Chicago, Ill. App. filed March 8, 1897. In an insulated hanger, the combination with a metallic hood, of lugs formed upon the interior thereof, a metallic ring supported by said lugs, a glass insulator retained in position within the hood by said ring, a hook, the shank whereof passes through said insulator and a disc secured to the end of said shank and supported by said insulator, said disc being of such diameter that it cannot pass through the ring.

593,626. ELECTRIC ARC LAMP; E. P. Warner, Chicago, Ill. App. filed March 16, 1897. In an electric arc lamp, the combination, with a chain or ribbon supporting the carbon, of a controlling wheel over which said chain or ribbon is passed, two rotatable clutching members mounted one at either side of said controlling wheel, link connections between said clutching members, whereby independent rotation of one of said members, with relation to the other, varies the distance between them, causing engagement or release of said controlling wheel, and electromagnetic means for causing such independent rotation, thereby to effect the regulation of the lamp.

593,627. TELEPHONE; J. Weil, Mansfield, Ohio. App. filed Feb. 25, 1897. The combination, with a generator box, of a shaft mounted therein, a lever pivotally mounted on said shaft and formed at its free end with a receiver hook, a crank mounted on said shaft, a rod pivotally connected to the end of said crank, a bow spring having one end secured to the casing of the box and the other pivotally mounted upon the lower end of the rod so as to normally force the same upward, a pivoted switch lever connected to said rod, and contacting points connected with the bell and main line circuits, and adapted to be engaged by said switch lever.

593,687. ELECTRIC ARC LAMP; C. C. Stirling, Hartford, Conn. App. filed Feb. 6, 1897. In an electric arc lamp, an actuator for the carbon-feeding mechanism, consisting of a motor comprising a field magnet in series with the carbons having two pairs of poles, a rotary armature between the poles of one pair, a normally open branch circuit therefor, a circuit closer for said branch circuit, a supplemental armature for operating said circuit closer, located opposite the poles of the other pair responsive to variations produced by the varying resistance of the arc.

593,689. INSULATOR; L. F. Rembe, Haverstraw, N. Y. App. filed March 17, 1897. An insulator, comprising a base having its ends rounded, a head raised from the centre of the base, said head being formed with a spiral groove, lugs raised from the base on opposite sides of the head and formed of the same contour as the head, said lugs having their upper edges inclined rearwardly and downwardly, hooks formed in the lugs, a projection raised from the base adjacent the hook of one of the lugs, and means for attaching the insulator to a support.

593,692. ELECTRIC SIGNALING MECHANISM; L. G. Rowand, Camden, N. J. App. filed Dec. 22, 1896. In combination, a main circuit, signaling devices on said circuit, receiving devices on said circuit, a switch device consisting of two members controlling said second device, the first member of which is moved in one direction by said electric device when energized, and means to return said member to its initial position when said electric device is de-energized, and a device adapted to hold said second switch member out of electric connection with said first switch member in its movement under the action of the electric device.

593,716. ALTERNATING-CURRENT MOTOR; A. J. Churchward, Brooklyn, N. Y. App. filed July 1, 1896. In an alternating-current motor, the combination, with the starting, winding and armature wound with any suitable direct-current generator or motor winding, to adapt the machine for self-starting operations, of a rectifying commutator and switch, and connections whereby said winding may be included in series with the armature and carry a continuous or direct current for synchronous running while the armature carries an alternating current.

593,718. ELECTRICALLY DRIVEN GAS MACHINE; T. J. Fay, Brooklyn, N. Y. App. filed Feb. 25, 1897. The combination, of a sealed gas-casing, an electric motor located outside thereof and whose field magnet system itself forms a sealed casing, and a sealed gas passage connecting the motor and casing together, and through which the armature shaft leads.

593,738. ELECTRIC ARC LAMP; W. H. Coughlin, Worcester, Mass. App. filed April 9, 1897. In a globe holder, a spindle having an opening therethrough with a solid metal bearing seat at the bottom of the opening, in combination with a swinging dog arranged in said opening, and having one end horizontally pivoted near the lower part thereof, its head or free end adapted to normally fall outward and project laterally from one side of the spindle with the side of the dog supported upon said solid bearing seat, said dog adapted to be turned upward within the opening to permit the globe-supporting collar to pass onto or from said spindle.

593,803. ELECTRIC BATTERY; W. W. Hanscom and A. Hough, San Francisco, Cal. App. filed April 21, 1897. The method of constructing elements for storage batteries, consisting in mixing litharge and sugar, setting the same by adding sulphate of ammonia, dissolving out part of the sugar and electrolytically reducing to spongy lead.

593,817. RHEOSTAT; G. J. Schneider, Detroit, Mich. App. filed March 5, 1897. The combination, with circuit-closing switch and movable contact of a rheostat, of a time-motor for actuating said movable contact to cut out resistance adapted to be started upon the closing of the switch, and

means for compelling the return of said movable contact before the opening of said switch.

593,819. TELEPHONE AND SIGNALING, OR CALLING SYSTEM; J. G. Smith, New York, N. Y. App. filed April 4, 1895. A signaling system, comprising a plurality of stations, a circuit for said stations divided into sections in each station, and electrically operated devices in each station arranged to be operated directly from any of the stations for connecting two sections of said circuit together to establish a through line between any two of said stations.

593,820. ELECTRIC SIGNALING OR CALLING SYSTEM; J. G. Smith, New York, N. Y. App. filed April 4, 1895. In a signaling or calling system, a plurality of stations, a circuit for said stations divided into sections in said stations, two magnets on said circuit in said stations, an armature for each of said magnets, one of said armatures being arranged to break the circuit of the signaling instrument in its station and to connect two sections of said circuit to partially establish a complete circuit through said station, the other of said armatures being arranged to temporarily break said circuit and to then complete the circuit.

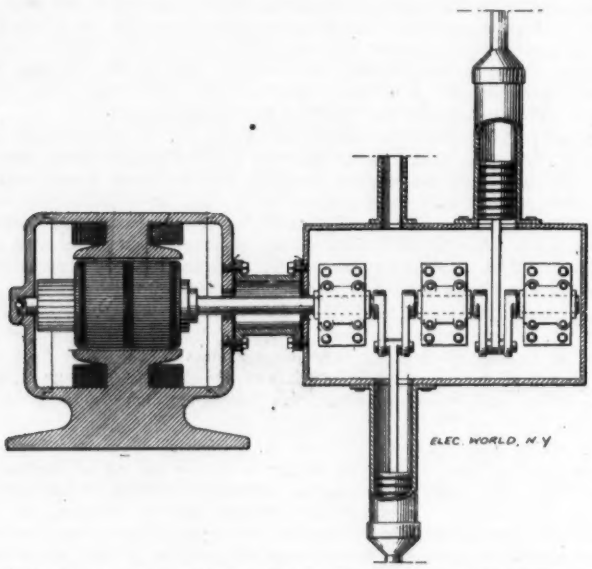
593,832. ELECTRIC BRAKE FOR ELEVATORS; J. P. Casey, Bloomsburg, Pa. App. filed August 28, 1894. The combination of a power shaft, an electric motor to rotate said shaft, a friction-gravity brake adapted to arrest the rotation of said shaft, an electromagnetic device for removing the said brake, provided with high and low resistance coils for producing the said polarities in the electromagnetic devices, an electric circuit, including the low-resistance coil in series with the armature, a shunt circuit including the high-resistance coil in shunt relation with the armature of the motor, and a switch device for controlling the flow of current through said circuits for always maintaining the current flowing in both coils of the brake magnet in the same direction at any moment of time.

593,841. METALLIC JUNCTION BOX AND MEANS FOR UNITING METAL CONDUIT TUBES THERETO; E. T. Greenfield, New York, N. Y. App. filed July 27, 1897. A metallic junction box, having one or more integral screw-threaded necks in combination with a metal conduit tube and a split nut exteriorly screw threaded, and adapted to firmly grip and hold the conduit tube in the integral neck.

593,842. FLEXIBLE ARMORED CONDUIT; E. T. Greenfield, New York, N. Y. App. filed Oct. 4, 1897. A flexible armored conduit tube, consisting of a flexible lining and two or more metallic armor strips spirally wound thereon and curved in opposite directions.

593,847. TROLLEY; O. L. Kirsch, West View, Pa. App. filed April 24, 1897. In a trolley, the combination of a base plate secured to the top of the car, a shaft or fulcrum pin secured to said plate, a base plate pivoted to said pin, a frame supported by the base plate, a plate journaled in said frame, a casing secured in said plate, having a collar in its upper end and a flange intermediate the ends, a trolley pole operating in said casing, a coil spring surrounding said pole and held in position by the collar and flange, the upper end of said spring being secured to the pole, a trolley wheel suitably secured in the end of the trolley pole, and coil springs secured to the plate and to the ends of the frames.

593,852. MULTIPLE METERING OF ELECTRIC CURRENTS; E. Oxley, Washington, D. C. App. filed Oct. 2, 1897. In a process of multiple-rate metering of electricity, the combination with suitable metering or registering apparatus of an electromagnetic device suitably located and arranged with relation to each point where a multiple rate is given, a normally open circuit for said electromagnetic device, and means located at a single point for establishing said circuit at suitable intervals, to control the metering or registering apparatus in showing the consumption of current at different rates.

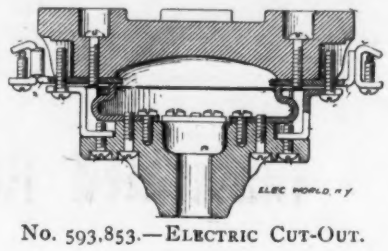


No. 593,718.—Electrically Driven Gas Machine.

593,853. ELECTRIC CUT-OUT; H. T. Paiste, Philadelphia, Pa. App. filed July 8, 1897. The combination, in an electrical cut-out, of the base having contact plates and line wire connections, a cap having plates forming electrical connection with the contact plates of the base, and other plates providing for mechanical connection therewith, and set screws for effecting this mechanical connection, the latter and the line wire connections being wholly outside of the limits of the cap, and the electrical connections being wholly inside of the same.

593,858. INDICATOR FOR ELECTRICAL MEASUREMENTS; E. B. Rosa, Middletown, Conn. App. filed July 13, 1897. In an apparatus for recording instantaneous values of electrical quantities, the combination, with an instantaneous contact maker, having a brush adapted to move periodically, of a recording surface adapted to move in synchronism with said brush, and means for recording the electrical values on said surface.

593,884. ELECTRIC ANNUNCIATOR; J. A. Gowans, Stratford, Canada. App. filed April 3, 1897. In an electric annunciator, a suitably-carried motor consisting of field magnets and a suitably supported rotatable armature, and a stop arm connected to the shaft of the armature of the motor, in combination with one or more electrically actuated stop mechanisms, and means for causing a current to pass through the motor and any one of the stop mechanisms, so as to draw the stop arm round to and arrest it at the said stop mechanism.

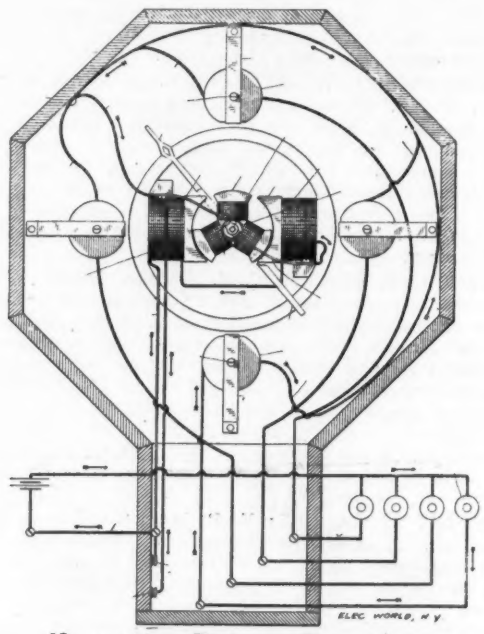


No. 593,853.—Electric Cut-Out.

593,899. ELECTRIC ARC LAMP; G. R. Lean, Cleveland, Ohio, deceased; J. Potter, same place, administrator. App. filed Jan. 23, 1897. The combination, with an arc-enclosing alternating-current arc lamp, of cored carbons, the cores of which are one-sixteenth of an inch in diameter or less.

593,914. ELECTRIC SWITCH; W. M. T. Weise, Davenport, Ia. App. filed Feb. 24, 1897. A telephone system, comprising a normally open combined talking and controlling circuit, including a rotatable central controlling member adapted to open and close said circuit alternately when rotated, telephones and rotatable switches for the telephones also included in said circuit, electromagnets also included in and energized by said circuit, magnet armatures adapted to actuate said telephone switches, a normally closed signal circuit, and a switch adapted to open and close said circuits alternately.

593,956. STREET AND STATION INDICATOR; S. E. Bisbee, South Pasadena, Cal. App. filed Aug. 28, 1896. In a street and station indicator, the combination of a take up roller, a display roller, an indicator ribbon passed around the display roller and arranged to positively rotate the same and wrapped upon the take-up roller, and having its end fastened thereto, means for driving the take-up roller to take up the ribbon and thereby positively rotate the display roller; an escapement to stop such mechanism; a stop wheel provided with stop notches and fixed on the display roller; a stop to stop the escapement and provided with a dog arranged to ride upon the stop wheel and to enter the said stop notches; and means to withdraw the dog from the stop wheel and the stop from the escapement.



No. 593,884.—Electric Annunciator.

593,965. COUPLING FOR ELECTRIC CIRCUITS IN RAILWAY TRAINS; J. Merryweather, Greencastle, Ind. App. filed Oct. 7, 1897. The combination, with a railway train having an electric signaling circuit, of coupling devices consisting of male and female coupling halves, adapted to be connected to the ends of the cars, and to engage with each other, each car being equipped with two of each form of coupling halves, one upon each end, the corresponding coupling halves being arranged in all cases diagonally opposite to each other.